

Lockheed Martin Information Systems & Global Solutions (IS&GS - Civil) Environmental Services SERAS 2890 Woodbridge Avenue, Building 209 Annex Edison, NJ 08837-3679

Telephone: 732-321-4200, Facsimile: 732-494-4021

DATE:

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TO:

Marc S. Greenberg, Ph.D. US EPA/OSRTI/TIFSD/ERT Work Assignment Manager

FROM:

Donna Getty, SERAS Statistician

Karen Kracko, SERAS/SRC Environmental Risk Assessor

THROUGH:

Jon McBurney, SERAS Engineering Group/Task Leader

SUBJECT:

TECHNICAL MEMORANDUM, DATA ANALYSIS FOR JANUARY 2012 PASSAIC RIVER RESIDUE SAMPLING RESULTS FOR DIOXINS, FURANS, DIOXIN-LIKE POLYCHLORINATED BIPHENYLS (PCBS), TOTAL PCBs, AND MERCURY, W.A.

0 - 156

The Lower Passaic River (LPR) is an operable unit of the Diamond Alkali Superfund Site located in Newark, New Jersey (NJ). In September 2011, the U.S. Environmental Protection Agency (EPA) Region 2 requested that the Environmental Response Team (ERT) conduct focused sampling of selected recreational use areas in the Lower Passaic River Study Area, North Arlington and Lyndhurst, NJ. The objective of this sampling effort was to provide a preliminary investigation of whether dioxins may have impacted recreational use areas due to the potential migration of contaminated sediments and their potential deposition on the soil surface as a result of recent flooding events. Specifically, residue (sediment) and associated surface soil samples were collected from recreational areas (e.g., football, soccer, and baseball fields) where flood waters associated with Hurricane Irene and Tropical Storm Lee had receded, to screen for the presence of dioxins, furans, and dioxin-like (DL) polychlorinated biphenyls (PCBs). Sampling was conducted from September 26 through 28, 2011. A summary of these field activities can be found in the SERAS Trip Report (SERAS-156-DTR-101911) (SERAS 2011a). An incremental sampling strategy was used to obtain representative estimates of average concentrations of these contaminants of concern (SERAS UFP QAPP, SERAS-156-DQAPP-092311) (SERAS 2011b) and to conduct a screening-level assessment of potential human health risks (SERAS Technical Memorandum, SERAS-156-DTM-110111) (SERAS 2011c).

In January 2012, EPA Region 2 requested additional support from the ERT to address concerns regarding potential impacts to public use areas along the low-lying floodplain adjacent to contaminated river mud flats. This area is within Riverside Park, Lyndhurst, NJ, at approximately river mile 10.9, and the tidal mud flats are contaminated with dioxin/furans, PCBs and mercury. The objective of the present effort was to provide a preliminary investigation of whether PCBs, dioxins and mercury may have impacted public use areas due to the potential migration of contaminated sediments and their potential deposition on the soil surface as a result of episodic flooding. An incremental sampling strategy, similar to the one

employed in September 2011, was used to assess the residual material that remains on surfaces within these public use areas. The sampling was conducted on January 30th and 31st, 2012.

Dioxins continue to be a risk driver at this site; PCBs also contribute to the calculated human health cancer risk based on an evaluation of fish consumption (Malcolm Pirnie Inc. 2007). As in the September investigation, the data will be used by EPA Region 2 to determine if conditions exist that could pose a concern for users of public areas that warrant further attention.

Three incremental soil samples (IS), one original and two replicate, were collected from each of the four decision units (DUs) under investigation. Decision units were identified as DU1, DU2, DU3 and DU4. Each IS was made up of 30 increments of surface soil [0 to 2 centimeters (cm)]. Increments were collected along a systematic grid, based on a random starting location, and established at each DU. Surface soil was collected per increment location to comprise a bulk IS which was analyzed for mercury (Hg), dioxins/furans, PCB Aroclors, and PCB congeners. An additional 8-oz jar was collected with the original IS from each field to accommodate a grain size analysis on the sample. The detailed descriptions of sampling activities can be found in the SERAS Quality Assurance Project Plan, Amendment 1 (SERAS-156-DQAPP1-012312, dated January 23, 2012) (SERAS 2012a); Work Plan, Amendment 1 (SERAS-156-DWPA1-020312, dated February 3, 2012) (SERAS 2012b); and Trip Report (SERAS-156-DTR-030712, dated March 7, 2012) (Appendix B) (SERAS 2012c).

Data analysis was conducted per procedures and recommendations outlined in the User Guide for the "Uniform Federal Policy Quality Assurance Project Plan Template for Soils Assessment of Dioxin Sites" (September 2011) (U.S. EPA 2011a). This document will be referred to as the Dioxin UFP QAPP User Guide throughout this memo.

Computation of Total Toxicity Equivalent Concentrations (TEQs)

In support of the toxicity equivalent concentration (TEQ)-based risk screening for the Passaic River Residue project, total TEQs were computed for each of the three replicates at each of the four DUs. The EPA Basic Kaplan-Meier Calculator (KM Calculator), a macro-driven Excel spreadsheet developed for use in conjunction with the UFP-QAPP dioxin soil sampling template, was used for the calculations (U.S. EPA 2011b). The EPA Advanced Kaplan-Meier Calculator was then used to conduct a statistical sensitivity analysis on the results. The KM Calculator was chosen to facilitate the mathematical computations involved with handling non-detect and estimated values in the calculation of representative means and standard deviations. The KM Calculator was developed by the EPA to support the calculation of TEQs and upper confidence limits based on those TEQs. The mathematical techniques used in the KM Calculator are based on Helsel (2005).

Analytical results from three classes of contaminants (twenty-nine analytes) were entered into the KM Calculator:

- Polychlorinated dibenzo-p-dioxins (PCDDs),
- Polychlorinated dibenzo furans (PCDFs), and
- Dioxin-like (DL) PCBs.

Tables 1a, 1b, 1c, and 1d contain a list of the dioxins, furans, and PCBs used in the calculations, their corresponding toxicity equivalence factors (TEFs), and analytical results. A separate KM Calculator file was created for each DU (Appendix A). Replicate results for a DU were entered into the same KM Calculator file. The laboratory reported one total concentration for PCB congeners 156 and 157, because they co-elute in the laboratory analysis. Since both congeners have the same TEF value (0.00003), this total concentration was divided in half and the result entered as the concentration value for each PCB 156

and 157 into the KM Calculator for data analysis purposes. This gave equal weight to both congeners in the data analysis.

Non-detects (results qualified with a U or UJ) and estimated values (results qualified with a J or EMPC) were included in the calculations. The reporting limit (RL) was entered for non-detects and the reported value was entered for results qualified with a J or EMPC (estimated maximum possible concentration). The first step of the TEQ computation multiplies the 2005 World Health Organization TEF (van den Berg et al. 2006) as adopted by EPA in 2010 (U.S. EPA 2010a) by the corresponding analytical result to achieve a TEQ for each dioxin-like chemical. The TEQs computed based on non-detects were also qualified as non-detect. These TEQs were then averaged using the non-parametric KM Calculator to achieve an "intermediate mean" TEQ per sample. From this intermediate mean, a Total TEQ per sample was determined (Table 2) through the computation which multiplied the intermediate mean TEQ by the number of compounds included in the analysis per sample. The Total TEQs for the three samples (original plus two replicates) were then averaged to achieve a mean Total TEQ for each DU.

The EPA Basic KM TEQ calculator was applied to each of the four DUs as described above. Mean Total TEQs were computed for DU1, DU2, and DU4. A more detailed analysis using the Advanced EPA KM TEQ calculator was required for DU3. Because the highest computed congener-specific toxicity equivalence concentration (TEC) was based on a non-detect for DU3-IS-003 (1,2,3,7,8 -PeCDD = 4.98 U), a sensitivity analysis was required using the Advanced KM TEQ Calculator. Two treatments for handling this non-detect value were applied based on recommendations presented in the General Instructions for the Calculator. First, a conservative estimation of the mean TEQ was computed using the RL(4.98 ppt [parts per trillion]) as a "donor" value for the non-detect; secondly the average concentration of 1,2,3,7,8 –PeCDD for DU3-IS-001 (0.586 ppt) and DU-IS-002 (0.401 ppt) was used as the "donor" value (0.493 ppt).

Mean Total TEQs were:

- 11.9 parts per trillion (ppt) for DU1,
- 11.7 ppt for DU2,
- 8.66 ppt (based on a donor value = 4.98 [RL]) and 7.17 ppt (based on a donor value = 0.493 ppt) for DU3, and
- 10.5 ppt for DU4.

Standard Deviation (SD), Relative Standard Deviation (RSD) of the TEQ, and 95% Upper Confidence Limit (UCL) on the Mean of the TEQ

Because triplicate samples were collected from each field (DU), a mean Total TEQ and a measure of variability could be computed for each DU. Measures of variability included in the computations were the TEQ standard deviation (SD) and relative standard deviation (RSD; also known as the coefficient of variation or CV). Both were computed through the KM Calculator. The SD was used in the equation to calculate the TEQ upper confidence limit (UCL) on the mean and to calculate the TEQ relative standard deviation (RSD).

As stated in the Dioxin UFP QAPP User Guide, 'The RSD is a measure of the variation among a group of sample results. It was used to assess the degree of variability between each set of DU replicates. The degree of variability is also related to the shape of the data distribution. A skewed shape (where one side is pulled out, for example, a lognormal distribution) has a higher RSD than a normal distribution. Therefore the RSD can be used as an indicator of the parent distribution from which the replicates came. Because IS results in much fewer samples than discrete sampling, RSD is the only statistical test that can be applied to determine distribution shape, since all standard statistical techniques require more than 3 data results. Computer simulations have led statisticians to make the following recommendations:

- If the TEQ RSD is low (i.e., less than 1.5), the Student's t-distribution is to be used to calculate the 95 percent (%) UCL on the mean for the TEQ.
- If the TEQ RSD is between 1.5 and 3, the non-parametric Chebyshev 95% UCL is used.
- If the TEQ RSD is high (greater than 3), the non-parametric Chebyshev 99% UCL is used. Although this is a 99% UCL by calculation, it is treated as a 95% UCL for the purposes of decision-making when the RSD is high.'

RSD for all four DUs were less than 1.5 (Table 2) ranging from a RSD of 0.075 at DU2 to 0.272 at DU1. Because of the low RSDs, it was assumed that data from each of the four DUs follow a normal or close to normal distribution. Therefore, in all cases the 95% UCL on the mean based on the Student's t-distribution was used for risk assessment.

The KM Calculator generated 95% UCLs based on the Student's t-distribution for the four DUs:

- 17.4 ppt for DU1,
- 13.2 ppt for DU2,
- 12.5 ppt (based on a donor value = 4.98 [RL]) and 9.84 ppt (based on a donor value = 0.493 ppt) for DU3, and
- 13.3 ppt for DU4.

Computation of Total PCBs Based on PCB Homologs

Total PCBs were computed by first summing individual congener concentrations to derive a concentration for the homolog groups, and then summing the concentrations of PCB homolog groups (Table 3) for each replicate in each DU (Table 4). Mean total PCBs were then computed by averaging the replicate total PCBs per DU. If the result of a homolog group was a non-detect, total PCBs was computed twice for that sample, first by substituting the RL for the non-detect, then again by substituting 0 for the non-detect. Monochlorobiphenyl was reported as a non-detect for all three replicates of DU3. Dichlorobiphenyl was also reported as not detected in DU3-IS-002 as well as in DU4-IS-003.

The same methodology that was used in the data analysis for the September 2011 sampling event was applied to this January 2011 event. In October 2011, for risk screening purposes, a conservative decision was made to use the total PCB concentration calculated by assuming that the actual concentration for a non-detect congener in a given sample was the indicated RL. This decision was made by the ERT WAM after seeking concurrence with EPA Region 2 and Office of Superfund Remediation and Technology Innovation (OSRTI) human health risk assessors. Total PCBs, Mean Total PCBs, SDs, and RSDs can be found in Table 4.

Mean Total PCBs:

- 36.1 parts per billion (ppb) for DU1,
- 27.3 ppb for DU2,
- 15.2 ppb (substituting RL for non-detect) and 15.1 ppb (substituting 0 for non-detect) for DU3, and
- 23.0 ppb (substituting RL for non-detect) and 22.7 ppb (substituting 0 for non-detect) for DU4.

The same method outlined above for the computation of 95% UCLs on the means for TEQs was applied to the computation of UCLs on the means for Total PCBs. For completeness all three UCL calculation techniques were conducted (Table 4.) Computations were done using an Excel spreadsheet and applying the following formulas:

Equation 1: The Student's t distribution 95% UCL=

Total PCB replicate mean + {(95% one-sided Student t factor x Total PCB SD)/[Square root of the number of (replicate) samples]}

Equation 2: The Chebyshev 95% UCL =

Total PCB replicate mean $+ \{(4.359 \text{ x Total PCB SD})/[\text{Square root of the number of (replicate) samples}]\}$

Equation 3: The Chebyshev 99% UCL =

Total PCB replicate mean + {(9.950 x Total PCB SD)/ [Square root of the number of (replicate) samples]}

The RSD was less than 1.5 for all four DUs. Therefore as stated above, a 95% UCL based on the Student's t-distribution was used for risk assessment.

95% UCLs on the mean for Total PCBs, based on the Student's t-distribution were as follows:

- 52.1 ppb for DU1,
- 31.7 ppb for DU2,
- 21.6 ppb (for substituting RL for non-detects and for substituting 0 for non-detects) for DU3, and
- 27.9 ppb (substituting RL for non-detect) and 27.8 ppb (substituting 0 for non-detect) for DU4.

Computation of Total PCBs Based on PCB Aroclors

Aroclors were analyzed in all of the IS soil samples collected from the four DUs. Aroclor analysis was requested to determine the composition of the PCBs in the LPR Study Area, so that an Oral Reference Dose (RfD) that was most representative of the observed total PCB mixture could be considered in the Preliminary Remediation Goal (PRG) calculations. The RL for Aroclor analysis is much higher than the RL for individual congener analysis, therefore the Aroclor data were considered to be more qualitative than quantitative. All Aroclors were reported as non-detect in all replicates for DU2, DU3, and DU4. Total PCBs were not computed from data that was 100% non-detects.

Only Aroclor 1260 was found at reportable levels in two replicates of DU1:

Sample Number	Location	Analyte	Result (µg/kg)	Reporting Limit (µg/kg)
156-0135	DU1-IS-002	Aroclor 1260	32.6 J	32
156-0136	DU1-IS-003	Aroclor 1260	45.2 J	32

μg/kg = micrograms per kilogram; J: estimated concentration

Total PCBs as a sum of PCB Aroclors were not computed for DU1 because the value would be based only on Aroclor 1260 analytical results.

There is no RfD for Aroclor 1260. As per EPA, for calculation of the PRGs for the human health screen, the RfD for Aroclor 1254 was used in the PRG calculations. Oral reference doses are only available for

Aroclor 1016 (0.00007 milligrams per kilograms per day [mg/kg-day]) and Aroclor 1254 (0.00002 mg/kg-day). Because the RfD for Aroclor 1254 is the most conservative, and because Aroclor 1254 is more similar to Aroclor 1260 than Aroclor 1016, the RfD for Aroclor 1254 was selected.

Evaluation of Mercury Results

Incremental samples from the four DUs were also analyzed for Hg. The replicate Hg results were averaged per DU and measures of variability computed (Table 5). The average total Hg concentrations ranged from 0.104 ppm at DU3 to 0.286 ppm at DU2 and were well below the regional screening level (RSL) for total Hg (23 ppm) and the RSL for methylmercury (7.8 ppm) (U.S. EPA 2010b). These RSLs are based on residential exposure for a young child (1-6 years of age). The inclusion of a screening value for methylmercury was considered to be appropriately conservative. Upper confidence limits for total Hg were computed following the same methodology utilized for total PCBs based on homologs (Equations 1, 2 and 3). Statistical computations are summarized in Table 5. The RSD was less than 1.5 for all DUs so, as discussed above, the 95% UCL on the mean based on the t-distribution was used for risk assessment.

95% UCLs on the mean for Hg based on the Student's t-distribution were as follows:

- 0.221 ppm for DU1,
- 0.330 ppm for DU2,
- 0.113 ppm for DU3, and
- 0.211 ppm for DU4.

Screening-Level Assessment of Potential Human Health Risks

Analytical results for all of the samples were evaluated in a screening-level assessment of potential human health risks. The 95% UCL and mean concentrations of Hg were compared with the EPA Regional Screening Level (RSL) for total Hg (based on mercuric chloride) and methylmercury in residential soil (U.S. EPA 2012 a,b). Data for dioxins and furans and DL-PCBs were evaluated using TEQs as outlined in U.S. EPA 2011a. As directed by EPA/ERT, the 95% UCL and mean concentrations of total TEQs and total PCBs were compared with the calculated PRGs for total TEQs and total PCBs. The PRGs were calculated following the procedures outlined in the Risk Assessment Guidance for Superfund: Volume I – Human Health Evaluation Manual (Part B, Development of Risk Based Preliminary Remediation Goals (Interim) (U.S. EPA 1991). The steps in the risk assessment process and the approach used in the PRG calculations were described in a U.S. EPA technical memorandum (U.S. EPA 2011c), portions of which are repeated below.

Hazard Identification and Dose-Response

The chemicals evaluated were Hg; 2,3,7,8 Tetrachlorodibenzo-p-dioxin (TCDD) TEQs; and PCBs. Based on the Weight of Evidence characterization for inorganic Hg and methylmercury in IRIS, inorganic Hg and methylmercury are classified as possible human carcinogens due to inadequate human data and limited evidence of carcinogenicity in animals (U.S. EPA 1995, U.S. EPA 2001). At the current time, the Weight of Evidence Classification for TCDD is a probable human carcinogen (U.S. EPA 1997a). In addition, the Weight of Evidence Classification for PCBs is as probable human carcinogens as discussed on the chemical-specific file for PCBs available on the Integrated Risk Information System (IRIS) classification (www.epa.gov/iris).

The toxicity values for total and methylmercury were identified as the EPA RSLs for total mercury (based on mercuric chloride) and methylmercury in residential soil (U.S. EPA 2010b).

Toxicity values for dioxins and PCBs were identified based on the hierarchy for selecting toxicity values for use in Superfund risk assessments outlined in OSWER Directive 9285.7-53 (U.S. EPA 2003), shown below:

• Tier 1- EPA's IRIS

- Tier 2- EPA's Provisional Peer Reviewed Toxicity Values (PPRTVs) The Office of Research and Development/National Center for Environmental Assessment/Superfund Health Risk Technical Support Center (STSC) develops PPRTVs on a chemical specific basis when requested by EPA's Superfund program.
- **Tier 3- Other Toxicity Values** Tier 3 includes additional EPA and non-EPA sources of toxicity information. Priority should be given to those sources of information that are the most current, the basis for which is transparent and publicly available, and which have been peer reviewed.

The following section discusses how toxicity values were selected for TCDD TEQ and PCBs.

Cancer Assessment – TCDD Tier 3 Values:

- EPA's Office of Health and Environmental Assessment (currently the EPA National Center for Environmental Assessment) developed a cancer slope factor (CSF) for 2,3,7,8-TCDD in 1985. The Health Assessment Document (HAD) provides a value for dioxin of 156,000 mg/kg-day⁻¹. This cancer slope factor is based on the study by Kociba *et al.* (1978).
- EPA's 1997 Health Effects Assessment Summary Table, or HEAST provides an oral CSF of 150,000 mg/kg-day⁻¹.
- California (CalEPA) developed an oral CSF 130,000 mg/kg-day⁻¹. This is based on the occurrence of hepatocellular adenomas and carcinomas in male mice in a study by the National Toxicology Program in 1982.

Cancer Assessment – PCBs Tier 1 Values:

• IRIS provides an oral cancer slope factor for PCBs of 2 mg/kg-day ⁻¹ and an inhalation unit risk factor for PCBs of 0.00057 micrograms per cubic meter (ug/m³).

Non-Cancer Health Assessment – Dioxins – Tier 1 Values:

• EPA's IRIS database provides a non-cancer RfD for TCDD of 7 X 10⁻¹⁰ (EPA 2012c). A RfD is defined as an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure for the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

Non-Cancer Health Assessment: - PCBs Tier 1 Values:

• EPA's IRIS database provides a non-cancer oral RfD for Aroclors 1254 and 1016 of 0.00002 mg/kg-day and 0.00007 mg/kg-day, respectively. For this assessment the oral RfD for Aroclor 1254 was used to calculate the PRGs. A route-to-route extrapolation based on systemic effects was used to develop an inhalation RfD based for PCBs of 0.000245 ug/m³.

Exposure Assessment:

Measured concentrations of mercury (Hg) in soil were compared with residential soil RSL values for a young child 1-6 years of age as a conservative approach (i.e., residential-exposure-based RSLs are the most health-protective RSLs available) to evaluate potential direct contact human exposure). Only total Hg was analyzed in soil samples. However, the measured total Hg concentration was compared with the RSL based on mercuric chloride (23 ppm) and the RSL for methylmercury (7.8 ppm). Although it was assumed that 100 percent (%) of the measured total Hg was the form being screened, the inclusion of a screening value for methylmercury was considered to be appropriately conservative. If measured concentrations of Hg in surface soils exceeded the above screening benchmarks, the need for a more detailed exposure assessment would be considered.

A detailed exposure assessment was conducted to estimate the cancer risks and non-cancer health hazards from human exposures to TCDD TEQ and PCBs within the study area.

Human exposures to TCDD-TEQ and PCBs in the environment are quantified in the PRG by determining the potential concentration of the contaminants in environmental media (e.g., soil), which humans may then ingest or otherwise contact, resulting in potential uptake of the chemicals into the body. The exposure assessment process involves determining the concentration of the contaminants in the environmental media of concern and combining this information with estimates of potential human exposures to the environmental media. The variability of environmental concentrations, the likelihood of exposure occurring via particular pathways, and the frequency and duration of human exposures are all components of the exposure assessment.

USEPA guidance and policy call for an evaluation of cancer risks and non-cancer health hazards to the Reasonably Maximally Exposed (RME) individual. An estimate for the RME individual can be obtained by determining estimates of likely "high-end" exposure factors and then combining these high-end factors with average factors to come up with a point estimate, or single value, for the RME individual.

Soil PRGs were calculated for use in evaluating results of the September 2011 field sampling effort. As described below, the calculation of the PRGs was based in part on default exposure assumptions and professional judgment regarding the frequency and duration of individuals playing on the fields. The following sections describe the potentially exposed individual and the associated exposure assumptions and their basis.

- Young Child (1 to 6 years). A young child (1 to 6 years) may be exposed 72 days/year for a period of six years. Exposures may occur while the child plays at the field during times where older siblings are involved in games or practices. Consistent with the PRG guidance, the exposure assumptions used in the calculation of the PRGs include an ingestion rate of 200 milligrams per day (mg/day) of soil and a bodyweight assumed to be 15 kilograms (kg). This may be a potential overestimate of risk since the ingestion rate is based on a residential value that assumes 24 of exposure and the time spent at the field may be lower. These exposure assumptions are applicable to utilization of the public use areas sampled in January 2012.
- Adolescents (7 to 18 years). Adolescents (7 to 18 years) may be exposed on a daily basis for 9 out of the 12 months of the year while practicing and playing various sports on the fields. The ingestion rate of 100 mg/day represents an estimate of incidental intake of soil that may occur as a result of hand-to-mouth activity. The mean bodyweight for the RME adolescent ages 7 to 18 years is 43 kg and represents the mean bodyweight of males and females within this age range. In addition for dermal exposures it was assumed the surface area of the body included the mean surface area of hands, forearms, lower legs, feet and face based on the average surface areas of males and females using data from the USEPA's 2011 Exposure Factors Handbook (U.S. EPA 2011d). These exposure

assumptions are probably a conservative estimate of exposure of adolescents to soil in the recreational and public use areas.

• Adult – Outdoor Worker. An adult outdoor worker may maintain the playing field and may be exposed to contaminated soils during these activities. Exposure assumptions used are the default assumptions provided in the U.S. EPA Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites (OSWER 9355.4-24, December 2002) (U.S. EPA 2002) and include a soil ingestion rate of 100 mg/day, and exposure 225 days/year for a period of 25 years. These exposure assumptions are applicable to utilization of the public use areas sampled in January 2012.

The PRGs developed by U.S. EPA (2011c) for this site are presented in Table 6.

Risk Characterization:

Risk characterization is the final step of the risk assessment process, which combines the information from the Toxicity Assessment (Hazard Identification and Dose-Response) and the Exposure Assessment steps to yield estimated PRGs associated with a non-cancer health hazard of 1 and a cancer risk within the risk range established under the National Oil and Hazardous Substances Pollution Contingency Plan or NCP, of 10⁻⁴ to 10⁻⁶ (1 in ten thousand to 1 in a million).

Exposures.

Mercury was added to the list of analytes for this phase of the Passaic River assessment because Hg was detected in recent samples collected from the river mud flats adjacent to Riverside Park. Direct contact human exposure with these materials was evaluated by comparing measured concentrations of Hg in soil with residential soil RSL values. The mean and 95% UCL on the mean concentrations of Hg measured in all four DUs are well below the surface soil screening benchmarks (Tables 7 and 8).

Dioxins and PCBs are the primary contributors to the calculated human health cancer risk associated with exposure to fish and shellfish from the Passaic River (Malcolm Pirnie Inc. 2007). The concern motivating the present sampling effort was that the public use areas in North Riverside Park were potentially impacted by sediment that migrated from the Passaic River during recent flooding events, and that over time, the deposited sediment integrate with the soils. PRGs associated with target cancer risks and non-cancer hazard indices were calculated based on reasonable maximum exposure of individuals (young children, adolescents, and outdoor workers) expected to utilize the public use areas. Exposure of individuals may occur through ingestion, inhalation, and dermal contact with soils, and these pathways were evaluated in calculating the PRG.

Cancer Assessment. The measured concentrations of total TEQs in soil at all four decision units fall below (DU2, DU3, DU4) or within (DU1) PRGs associated with the target risk range for carcinogens established in the NCP (Tables 7 and 8). Cleanup concentrations at Superfund sites should achieve a level of risk within the 10^{-4} to 10^{-6} carcinogenic risk range based on the reasonable maximum exposure for an individual. Cancer risks are described as the likelihood of additional (excess) cancers under the exposure assumptions described above. For example, a 10^{-6} risk means that one additional cancer case would be expected to occur per 1,000,000 people exposed under the exposure assumptions described above.

The 95% UCL on the mean concentration of total TEQs measured in soil collected from DU1 falls within the 10^{-4} to 10^{-6} (1 in ten thousand to 1 in a million) carcinogenic risk range for RME adolescent (ages 7 to 18 years) and outdoor workers (18 years and older) exposed to site soils (Table 7). The measured total TEQs in soil at DU1 are close to, but below, the PRG calculated for a cancer risk of 10^{-6} , and well below the PRG calculated for a cancer risk of 10^{-6} for the young child (ages 1 to 6 years). Measured total TEQs

in soil collected from DU2, DU3, and DU4 are below the calculated target risk range for all exposure scenerios.

Cancer risk from total TEQs was evaluated using the PRG calculated with the HAD cancer slope factor (CSF). Two additional CSFs were identified, one derived from the Health Effects Assessment Summary Table (HEAST) and one from CalEPA. The PRGs calculated using the HAD CSF is lower than the PRGs calculated using either the HEAST CSF or the CalEPA CSF (for example, for the young child the PRG values would be 26.2, 27.3, and 31.5 ppt, respectively; Table 6). Use of either of the PRGs calculated with the alternate CSFs would result in the same risk conclusion as the PRG calculated with the HAD CSF.

None of the mean or 95% UCL on the mean concentrations of total PCBs measured in soil collected at the four DUs exceeded the calculated human health screening benchmarks (Tables 7 and 8).

Non-Cancer Hazard Assessment. The evaluation of non-cancer health effects involves a comparison of average daily exposure levels with established RfDs to determine whether estimated exposures exceed recommended limits to protect against chronic adverse health hazards (i.e., hazard index [HI] at or below 1). Measured concentrations of total TEQs and total PCBs were well below PRGs based on a target non-carcinogenic HI of 1 at all four DUs.

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Table 1a. Dioxin, Furans and Dioxin-Like Congeners Used in Total TEQ Computations Decision Unit 1 (DU1) Passaic River Residue Assessment - March 2012

	World Health				Sample	Location		
Kaplan-Meier	Organization 2005		DU1-	IS-001	DU1-	IS-002	DU1-	-IS-003
Calculator Analyte	Toxicity Equivalence	Analyte Name from	Result ^{1,2}		Result ^{1,2}		Result ^{1,2}	
Abbreviation	Factors	Laboratory EDD	(pg/g)	Qualifier	(pg/g)	Qualifier	(pg/g)	Qualifier
TCDD	1	2,3,7,8-TCDD	3.05		6.34		3.75	
PeCDD	1	1,2,3,7,8-PeCDD	0.832	J	0.963	J	0.884	J
1,4-HxCDD	0.1	1,2,3,4,7,8-HxCDD	1.14	J	1.35	J	1.22	J
1,6-HxCDD	0.1	1,2,3,6,7,8-HxCDD	2.27	J	3.42	J	2.86	J
1,9-HxCDD	0.1	1,2,3,7,8,9-HxCDD	1.77	EMPC	2.91	J	2.72	J
1,4,6-HpCDD	0.01	1,2,3,4,6,7,8-HpCDD	50.8		67.3		59.8	
OCDD	0.0003	OCDD	641		852		776	
TCDF	0.1	2,3,7,8-TCDF	3.16		4.65		3.75	
1-PeCDF	0.03	1,2,3,7,8-PeCDF	1.52	J	2.40	J	1.91	J
8-PeCDF	0.3	2,3,4,7,8-PeCDF	2.34	J	3.28	J	2.91	J
1,4-HxCDF	0.1	1,2,3,4,7,8-HxCDF	5.94		8.29		6.55	
1,6-HxCDF	0.1	1,2,3,6,7,8-HxCDF	2.58	J	4.18	J	3.60	J
1,9-HxCDF	0.1	1,2,3,7,8,9-HxCDF	5.01	U	5.00	U	5.00	U
4,6-HxCDF	0.1	2,3,4,6,7,8-HxCDF	2.16	J	3.37	J	2.91	J
1,4,6-HpCDF	0.01	1,2,3,4,6,7,8-HpCDF	39.2		63.2		52.1	
1,4,9-HpCDF	0.01	1,2,3,4,7,8,9-HpCDF	1.73	EMPC	2.79	J	2.38	J
OCDF	0.0003	OCDF	56.5		94.1		78.6	
PCB 77	0.0001	PCB 77	91.9		140		129	
PCB 81	0.0003	PCB 81	2.00	U	2.12	U	2.93	U
PCB 105	0.00003	PCB 105	547		839		655	
PCB 114	0.00003	PCB 114	18.9		26.9		20.9	
PCB 118	0.00003	PCB 118	1080		1660		1310	
PCB 123	0.00003	PCB 123	23.1		42.0		35.4	
PCB 126	0.1	PCB 126	12.0		23.7		17.3	
PCB 156	0.00003	PCB 156	132	_	217	_	158	
PCB 157	0.00003	PCB 157	132		217		158	
PCB 167	0.00003	PCB 167	105		163		127	
PCB 169	0.03	PCB 169	2.00	U	2.85	U	3.58	U
PCB 189	0.00003	PCB 189	22.9		40.0		34.6	

 $^{^{1}\}mbox{Reported}$ results for data qualified with a U is the reporting limit.

EMPC: Estimated maximum possible concentration

pg/g = picograms per gram

²The same analytical result was reported by the laboratory for both PCB 156 and PCB 157, although this concentration actually reflects the combined concentration for the two coeluting PCBs. This total concentration was divided in half for computation of Total TEQs (both PCB 156 and PCB 157 have the same TEF) and upper confidence limits.

J: Estimated value

U: Not detected under the reporting limit

Table 1b. Dioxin, Furans and Dioxin-Like Congeners Used in Total TEQ Computations Decision Unit 2 (DU2) Passaic River Residue Assessment - March 2012

	World Health				Sample	e Location		
Kaplan-Meier	Organization 2005		DU2-	IS-001	DU2-	·IS-002	DU2-	IS-003
Calculator Analyte	Toxicity Equivalence	Analyte Name from	Result ^{1,2}		Result ^{1,2}		Result ^{1,2}	
Abbreviation	Factors	Laboratory EDD	(pg/g)	Qualifier	(pg/g)	Qualifier	(pg/g)	Qualifier
TCDD	1	2,3,7,8-TCDD	5.99		5.03		5.65	
PeCDD	1	1,2,3,7,8-PeCDD	0.588	EMPC	0.460	EMPC	0.788	J
1,4-HxCDD	0.1	1,2,3,4,7,8-HxCDD	0.722	EMPC	0.674	J	0.933	J
1,6-HxCDD	0.1	1,2,3,6,7,8-HxCDD	2.03	J	1.61	J	1.98	J
1,9-HxCDD	0.1	1,2,3,7,8,9-HxCDD	1.57	J	1.67	J	1.89	J
1,4,6-HpCDD	0.01	1,2,3,4,6,7,8-HpCDD	36.3		30.8		40.1	
OCDD	0.0003	OCDD	410		353		468	
TCDF	0.1	2,3,7,8-TCDF	3.86		3.72		3.98	
1-PeCDF	0.03	1,2,3,7,8-PeCDF	1.50	J	1.58	J	1.80	J
8-PeCDF	0.3	2,3,4,7,8-PeCDF	1.97	J	1.87	J	2.25	J
1,4-HxCDF	0.1	1,2,3,4,7,8-HxCDF	3.94	J	4.11	J	4.77	J
1,6-HxCDF	0.1	1,2,3,6,7,8-HxCDF	2.05	J	2.11	EMPC	2.29	J
1,9-HxCDF	0.1	1,2,3,7,8,9-HxCDF	0.124	EMPC	5.00	U	5.03	U
4,6-HxCDF	0.1	2,3,4,6,7,8-HxCDF	2.01	J	1.92	J	2.23	J
1,4,6-HpCDF	0.01	1,2,3,4,6,7,8-HpCDF	28.2		26.8		38.9	
1,4,9-HpCDF	0.01	1,2,3,4,7,8,9-HpCDF	1.27	J	1.30	J	1.53	J
OCDF	0.0003	OCDF	44.5		42.1		65.2	
PCB 77	0.0001	PCB 77	134		165		149	
PCB 81	0.0003	PCB 81	4.00		4.13		4.84	
PCB 105	0.00003	PCB 105	546		565		659	
PCB 114	0.00003	PCB 114	27.3		28.3		31.4	
PCB 118	0.00003	PCB 118	1060		1090		1260	
PCB 123	0.00003	PCB 123	24.5		21.6		25.3	
PCB 126	0.1	PCB 126	20.7		21.4		23.2	
PCB 156	0.00003	PCB 156	124		125		142	
PCB 157	0.00003	PCB 157	124		125		142	
PCB 167	0.00003	PCB 167	91.0		90.0		106	
PCB 169	0.03	PCB 169	2.00	U	2.00	U	2.01	U
PCB 189	0.00003	PCB 189	20.8		20.1		24.1	

¹Reported results for data qualified with a U is the reporting limit.

U: Not detected under the reporting limit EMPC: Estimated maximum possible concentration

pg/g = picograms per gram

²The same analytical result was reported by the laboratory for both PCB 156 and PCB 157, although this concentration actually reflects the combined concentration for the two coeluting PCBs. This total concentration was divided in half for computation of Total TEQs (both PCB 156 and PCB 157 have the same TEF) and upper confidence limits.

J: Estimated value

Table 1c. Dioxin, Furans and Dioxin-Like Congeners Used in Total TEQ Computations Decision Unit 3 (DU3)

Passaic River Residue Assessment - March 2012

	World Health				Sample	e Location		
Kaplan-Meier	Organization 2005		DU3-	IS-001	DU3-	·IS-002	DU3-	-IS-003
Calculator Analyte	Toxicity Equivalence	Analyte Name from	Result ^{1,2}		Result ^{1,2}		Result ^{1,2}	
Abbreviation	Factors	Laboratory EDD	(pg/g)	Qualifier	(pg/g)	Qualifier	(pg/g)	Qualifier
TCDD	1	2,3,7,8-TCDD	3.43		2.26		2.15	EMPC
PeCDD	1	1,2,3,7,8-PeCDD	0.586	J	0.401	J	4.98	U
1,4-HxCDD	0.1	1,2,3,4,7,8-HxCDD	0.592	EMPC	0.49	EMPC	0.446	EMPC
1,6-HxCDD	0.1	1,2,3,6,7,8-HxCDD	1.39	J	1.28	J	1.17	J
1,9-HxCDD	0.1	1,2,3,7,8,9-HxCDD	1.68	J	1.24	EMPC	1.05	EMPC
1,4,6-HpCDD	0.01	1,2,3,4,6,7,8-HpCDD	30.7		22.0		20.9	
OCDD	0.0003	OCDD	473		333		287	
TCDF	0.1	2,3,7,8-TCDF	3.30		1.99		1.88	
1-PeCDF	0.03	1,2,3,7,8-PeCDF	1.34	J	1.10	J	1.19	J
8-PeCDF	0.3	2,3,4,7,8-PeCDF	1.97	J	1.44	J	1.55	J
1,4-HxCDF	0.1	1,2,3,4,7,8-HxCDF	3.99	J	3.16	J	4.63	J
1,6-HxCDF	0.1	1,2,3,6,7,8-HxCDF	2.11	J	1.31	J	1.65	J
1,9-HxCDF	0.1	1,2,3,7,8,9-HxCDF	5.00	U	4.97	U	4.98	U
4,6-HxCDF	0.1	2,3,4,6,7,8-HxCDF	1.74	J	1.32	J	1.27	J
1,4,6-HpCDF	0.01	1,2,3,4,6,7,8-HpCDF	26.1		18.0		19.8	
1,4,9-HpCDF	0.01	1,2,3,4,7,8,9-HpCDF	1.10	EMPC	1.01	J	0.927	J
OCDF	0.0003	OCDF	38.6		25.7		27.4	
PCB 77	0.0001	PCB 77	113		61.6		56.6	
PCB 81	0.0003	PCB 81	3.26		2.31		2.00	
PCB 105	0.00003	PCB 105	455		310		293	
PCB 114	0.00003	PCB 114	22.2		14.2		13.1	
PCB 118	0.00003	PCB 118	886		610		578	
PCB 123	0.00003	PCB 123	18.5		13.9		13.1	
PCB 126	0.1	PCB 126	19.0		13.7		12.6	
PCB 156	0.00003	PCB 156	118		79		75	
PCB 157	0.00003	PCB 157	118		79		75	
PCB 167	0.00003	PCB 167	88.4		59.6		56.3	
PCB 169	0.03	PCB 169	2.43		1.99	U	1.99	U
PCB 189	0.00003	PCB 189	18.1		12.2		12.2	

¹Reported results for data qualified with a U is the reporting limit.

J: Estimated value

U: Not detected under the reporting limit EMPC: Estimated maximum possible concentration pg/g = picograms per gram

²The same analytical result was reported by the laboratory for both PCB 156 and PCB 157, although this concentration actually reflects the combined concentration for the two coeluting PCBs. This total concentration was divided in half for computation of Total TEQs (both PCB 156 and PCB 157 have the same TEF) and upper confidence limits.

Table 1d. Dioxin, Furans and Dioxin-Like Congeners Used in Total TEQ Computations Decision Unit 4 (DU4)

Passaic River Residue Assessment - March 2012

	World Health				Sample	Location		
Kaplan-Meier	Organization 2005		DU4-	IS-001	DU4-	·IS-002	DU4	-IS-003
Calculator Analyte	Toxicity Equivalence	Analyte Name from	Result ^{1,2}		Result ^{1,2}		Result ^{1,2}	
Abbreviation	Factors	Laboratory EDD	(pg/g)	Qualifier	(pg/g)	Qualifier	(pg/g)	Qualifier
TCDD	1	2,3,7,8-TCDD	5.50		4.21		6.57	
PeCDD	1	1,2,3,7,8-PeCDD	0.586	J	0.572	J	0.575	EMPC
1,4-HxCDD	0.1	1,2,3,4,7,8-HxCDD	0.761	EMPC	0.987	J	0.862	J
1,6-HxCDD	0.1	1,2,3,6,7,8-HxCDD	2.12	J	1.72	J	2.40	J
1,9-HxCDD	0.1	1,2,3,7,8,9-HxCDD	1.64	EMPC	1.86	J	1.87	J
1,4,6-HpCDD	0.01	1,2,3,4,6,7,8-HpCDD	39.4		41.2		47.4	
OCDD	0.0003	OCDD	447		488		648	
TCDF	0.1	2,3,7,8-TCDF	2.20		2.31		2.43	
1-PeCDF	0.03	1,2,3,7,8-PeCDF	1.27	J	1.30	J	1.28	J
8-PeCDF	0.3	2,3,4,7,8-PeCDF	1.62	J	1.78	J	1.79	J
1,4-HxCDF	0.1	1,2,3,4,7,8-HxCDF	4.13	J	4.26	J	4.35	J
1,6-HxCDF	0.1	1,2,3,6,7,8-HxCDF	2.12	J	2.08	J	2.31	J
1,9-HxCDF	0.1	1,2,3,7,8,9-HxCDF	0.122	EMPC	4.96	U	5.02	U
4,6-HxCDF	0.1	2,3,4,6,7,8-HxCDF	1.91	J	1.85	J	1.91	J
1,4,6-HpCDF	0.01	1,2,3,4,6,7,8-HpCDF	32.0		32.3		35.6	
1,4,9-HpCDF	0.01	1,2,3,4,7,8,9-HpCDF	1.55	J	1.74	J	1.76	J
OCDF	0.0003	OCDF	50.3		49.4		56.1	
PCB 77	0.0001	PCB 77	95.5		72.6		104	
PCB 81	0.0003	PCB 81	2.46		1.98	U	2.73	
PCB 105	0.00003	PCB 105	395		351		431	
PCB 114	0.00003	PCB 114	16.7		15.5		17.6	
PCB 118	0.00003	PCB 118	781		732		894	
PCB 123	0.00003	PCB 123	17.9		19.0		22.1	
PCB 126	0.1	PCB 126	13.4		10.6		16.6	
PCB 156	0.00003	PCB 156	101		98.5		121	
PCB 157	0.00003	PCB 157	101		98.5		121	
PCB 167	0.00003	PCB 167	77.9		79.7		96.5	
PCB 169	0.03	PCB 169	2.00	U	1.98	U	2.01	U
PCB 189	0.00003	PCB 189	17.9	_	17.7		21.0	_

¹Reported results for data qualified with a U is the reporting limit.

J: Estimated value

U: Not detected under the reporting limit EMPC: Estimated maximum possible concentration pg/g = picograms per gram

²The same analytical result was reported by the laboratory for both PCB 156 and PCB 157, although this concentration actually reflects the combined concentration for the two coeluting PCBs. This total concentration was divided in half for computation of Total TEQs (both PCB 156 and PCB 157 have the same TEF) and upper confidence limits.

Table 2. Computation of Means and Upper Confidence Limits for Total TEQs Using the EPA Basic Kaplan-Meier Toxicity Equivalents Calculator Passaic River Residue Assessment - March 2012

Location	Replicate	Fraction from Nondetect and Estimated Values	Sample Mean Total TEQ (ppt)	Qualifier for Intermediate Mean Total TEQ*	Mean Total TEQ of Replicate Total TEQ (ppt)	Standard Deviation of Replicate Means (ppt)	Relative Standard Deviation	95% UCL based on t- distribution (ppt)	95% Chebyshev UCL (ppt)	99% Chebyshev UCL (ppt)
	1	33%	9.03							
DU1	3	26% 32%	15.4 11.3		11.9	3.20	0.272	17.4	20.0	30.5
	1	21%	11.8							
DU2	2	26%	10.7		11.7	0.900	0.075	13.2	13.9	16.7
	3	27%	12.5							
DU3	1	31%	8.10							
(donor value = 4.98 ppt,	2	35%	6.24		8.66	2.27	0.262	12.5	14.4	21.7
Reporting Limit)	3	82%	10.80	J						
DU3	1	31%	8.10							
(donor value = 0.493 ppt,	2	35%	6.24		7.17	1.58	0.220	9.84	11.2	16.3
average of Replicate 1 & 2)	3	82%	6.28	J						
	1	24%	10.4	-	_					
DU4	2	32%	8.10		10.5	1.6	0.154	13.3	14.6	19.9
	3	24%	12.2							

TEQ = toxicity equivalents

ppt = parts per trillion

% = percent

UCL = upper confidence limit

Shaded cells are the recommended UCL based on recommendations from the Dioxin UFP QAPP User Guide:

If the RSD is <1.5, use the t-distribution based, 1-sided 95% UCL.

If the RSD is between 1.5 and 3, use the 95% Chebyshev UCL.

If the RSD >3, use the 99% Chebyshev UCL

^{*}Total TEQ computations based on greater than 50% estimated or nondetect values are qualified with a J.

Table 3. PCB Homolog Group Data Used to Compute Total PCBs Passaic River Residue Assessment - March 2012

				Reporting Limit
Location	Analyte	Result (pg/g)	Qualifier	(pg/g)
	DI	J1		•
	Monochlorobiphenyl (total)	41.4		20.0
	Dichlorobiphenyl (total)	333		20.0
	Trichlorobiphenyl (total)	1010	J	20.0
	Tetrachlorobiphenyl (total)	2630		20.0
5114 15 004	Pentachlorobiphenyl (total)	6910	J	20.0
DU1-IS-001	Hexachlorobiphenyl (total)	5930		20.0
	Heptachlorobiphenyl (total)	5140	J	20.0
	Octachlorobiphenyl (total)	2110		20.0
	Nonachlorobiphenyl (total)	1110		20.0
	PCB 209 (BZ)	1970		20.0
	Monochlorobiphenyl (total)	90.2		20.0
	Dichlorobiphenyl (total)	453		20.0
	Trichlorobiphenyl (total)	1600		20.0
	Tetrachlorobiphenyl (total)	4260		20.0
	Pentachlorobiphenyl (total)	10800		20.0
DU1-IS-002	Hexachlorobiphenyl (total)	12800		20.0
	Heptachlorobiphenyl (total)	9420		20.0
	Octachlorobiphenyl (total)	3550		20.0
	Nonachlorobiphenyl (total)	1270		20.0
	PCB 209 (BZ)	1830		20.0
	Monochlorobiphenyl (total)	51.8		20.0
	Dichlorobiphenyl (total)	495		20.0
	Trichlorobiphenyl (total)	1270		20.0
	Tetrachlorobiphenyl (total)	3400		20.0
5114 15 666	Pentachlorobiphenyl (total)	8390		20.0
DU1-IS-003	Hexachlorobiphenyl (total)	9160		20.0
	Heptachlorobiphenyl (total)	7350		20.0
	Octachlorobiphenyl (total)	2620		20.0
	Nonachlorobiphenyl (total)	904		20.0
	PCB 209 (BZ)	1290		20.0
	DU	J2		·
	Monochlorobiphenyl (total)	61.9		20.0
	Dichlorobiphenyl (total)	487		20.0
	Trichlorobiphenyl (total)	1190	J	20.0
	Tetrachlorobiphenyl (total)	4330		20.0
D.12 12 22 2	Pentachlorobiphenyl (total)	7160		20.0
DU2-IS-001	Hexachlorobiphenyl (total)	6400	J	20.0
	Heptachlorobiphenyl (total)	4060	J	20.0
	Octachlorobiphenyl (total)	1600	J	20.0
	Nonachlorobiphenyl (total)	528		20.0
	PCB 209 (BZ)	327		20.0

Table 3. PCB Homolog Group Data Used to Compute Total PCBs Passaic River Residue Assessment - March 2012

	Monochlorobiphenyl (total)	130	T 1	20.0
	Dichlorobiphenyl (total)	403	J	20.0
	Trichlorobiphenyl (total)	1300		20.0
	Tetrachlorobiphenyl (total)	4120		20.0
	Pentachlorobiphenyl (total)	7060		20.0
DU2-IS-002	Hexachlorobiphenyl (total)	6230		20.0
	Heptachlorobiphenyl (total)	3870	J	20.0
	Octachlorobiphenyl (total)	1610	J	20.0
	Nonachlorobiphenyl (total)	561		20.0
	PCB 209 (BZ)	266		20.0
	Monochlorobiphenyl (total)	63.0		20.1
	Dichlorobiphenyl (total)	478		20.1
	Trichlorobiphenyl (total)	1580		20.1
	Tetrachlorobiphenyl (total)	4930		20.1
	Pentachlorobiphenyl (total)	8490		20.1
DU2-IS-003	Hexachlorobiphenyl (total)	7200		20.1
	Heptachlorobiphenyl (total)	4680		20.1
	Octachlorobiphenyl (total)	1870		20.1
	Nonachlorobiphenyl (total)	656		20.1
	PCB 209 (BZ)	390		20.1
	DL	13		
	Monochlorobiphenyl (total)	20.0	U	20.0
	Dichlorobiphenyl (total)	80.5		20.0
	Trichlorobiphenyl (total)	521		20.0
	Tetrachlorobiphenyl (total)	1900		20.0
DU3-IS-001	Pentachlorobiphenyl (total)	5590	J	20.0
003-13-001	Hexachlorobiphenyl (total)	5630	J	20.0
	Heptachlorobiphenyl (total)	3420	J	20.0
	Octachlorobiphenyl (total)	1470	J	20.0
	Nonachlorobiphenyl (total)	585	J	20.0
	PCB 209 (BZ)	383		20.0
	Monochlorobiphenyl (total)	19.9	U	19.9
	Dichlorobiphenyl (total)	19.9	U	19.9
	Trichlorobiphenyl (total)	419	J	19.9
	Tetrachlorobiphenyl (total)	1365	J	19.9
DU3-IS-002	Pentachlorobiphenyl (total)	3770	J	19.9
DU3-13-002	Hexachlorobiphenyl (total)	3610	J	19.9
	Heptachlorobiphenyl (total)	2230	J	19.9
	Octachlorobiphenyl (total)	969	J	19.9
	Nonachlorobiphenyl (total)	391	J	19.9
	PCB 209 (BZ)	194		19.9

Table 3. PCB Homolog Group Data Used to Compute Total PCBs Passaic River Residue Assessment - March 2012

	Monochlorobiphenyl (total)	19.9	U	19.9
	Dichlorobiphenyl (total)	156	 	19.9
	Trichlorobiphenyl (total)	486		19.9
	Tetrachlorobiphenyl (total)	1430	J	19.9
	Pentachlorobiphenyl (total)	3690	J	19.9
DU3-IS-003	Hexachlorobiphenyl (total)	3430	J	19.9
	Heptachlorobiphenyl (total)	2170	J	19.9
	Octachlorobiphenyl (total)	984		19.9
	Nonachlorobiphenyl (total)	386		19.9
	PCB 209 (BZ)	194		19.9
	DL	J4	<u> </u>	
	Monochlorobiphenyl (total)	47.5		20.0
	Dichlorobiphenyl (total)	90.5		20.0
	Trichlorobiphenyl (total)	761	J	20.0
	Tetrachlorobiphenyl (total)	1936		20.0
D114 15 004	Pentachlorobiphenyl (total)	5170	J	20.0
DU4-IS-001	Hexachlorobiphenyl (total)	5010		20.0
	Heptachlorobiphenyl (total)	3590	J	20.0
	Octachlorobiphenyl (total)	1800		20.0
	Nonachlorobiphenyl (total)	948	J	20.0
	PCB 209 (BZ)	824		20.0
	Monochlorobiphenyl (total)	23.7		19.8
	Dichlorobiphenyl (total)	52.6		19.8
	Trichlorobiphenyl (total)	600		19.8
	Tetrachlorobiphenyl (total)	1640		19.8
DU4-IS-002	Pentachlorobiphenyl (total)	4360		19.8
DU4-13-002	Hexachlorobiphenyl (total)	4950		19.8
	Heptachlorobiphenyl (total)	3980		19.8
	Octachlorobiphenyl (total)	2330	J	19.8
	Nonachlorobiphenyl (total)	1390		19.8
	PCB 209 (BZ)	2660	J	19.8
	Monochlorobiphenyl (total)	54		20.1
	Dichlorobiphenyl (total)	20.1	U	20.1
	Trichlorobiphenyl (total)	775		20.1
	Tetrachlorobiphenyl (total)	2080		20.1
DIT4 15 003	Pentachlorobiphenyl (total)	5430		20.1
DU4-IS-003	Hexachlorobiphenyl (total)	6170		20.1
	Heptachlorobiphenyl (total)	4580		20.1
	Octachlorobiphenyl (total)	2490		20.1
	Nonachlorobiphenyl (total)	1620		20.1
	PCB 209 (BZ)	2870	J	20.1

pg/g = picograms per gram

J: Estimated value

U: Not detected under the reporting limit

Table 4. Computation of Means and Upper Confidence Limits for Total PCBs Based on the Summation of PCB Homolog Groups Passaic River Residue Assessment - March 2012

			Total PCBs ¹	Average Total PCBs	Standard Deviation of Total PCBs	Relative Standard	95% UCL based	· ·	99% Chebyshev UCL
	Decision Unit	Replicate	(ppt)	(ppt)	(ppt)	Deviation	(ppt)	(ppt)	(ppt)
		1	27,200						
	DU1	2	46,100	36,100	9,500	0.263	52,100	60,000	90,600
		3	34,900						
		1	26,100						
	DU2	2	25,600	27,300	2,610	0.095	31,700	33,900	42,300
		3	30,300						
	With Nondetects Set to the	1	19,600	15,200					
	Reporting Limit:	2	13,000		3,830	0.252	21,600	24,800	37,200
DU3		3	12,900						
D03		1	19,600						
	With Nondetects Set to 0:	2	12,900	15,100	3,840	0.253	21,600	24,800	37,200
		3	12,900						
	With Nondetects Set to the	1	20,200						
	Reporting Limit:	2	22,000	23,000	3,030	0.133	27,900	30,400	40,200
DU4	DU4	3	26,100						
		1	20,200						
	With Nondetects Set to 0:		22,000	22,700	3,020	0.133	27,800	30,300	40,100
		3	26,100						

¹Total PCBs computed by summing homolog groups:

<u>Notes</u>

If the result of a homolog group was a non-detect, total PCBs was computed twice for that sample by substituting:

- 1) the reporting limit for the non-detect
- 2) 0 for the non-detect

Monochlorobiphenyl was reported as a non-detect for all three replicates of DU3; Reporting Limit=20.0 ppt. Dichlorobiphenyl was reported as not detected in DU3-IS-002 (RL = 19.9 ppt) as well as in DU4-IS-003 (RL =20.1).

Table 5. Computation of Means and Upper Confidence Limits for Mercury in Soil
Passaic River Residue Assessment - March 2012

Decision Unit	Replicate	Mercury* (mg/kg)	Average Mercury (mg/kg)	Standard Deviation of Mercury (mg/kg)	Relative Standard Deviation	95% UCL based on t-distribution (mg/kg)	95% Chebyshev UCL (mg/kg)	99% Chebyshev UCL (mg/kg)
	1	0.192						
DU1	2	0.214	0.201	0.0114	0.0565	0.221	0.230	0.267
	3	0.198						
	1	0.286						
DU2	2	0.260	0.286	0.0260	0.0909	0.330	0.351	0.435
	3	0.312						
	1	0.0980						
DU3	2	0.106	0.104	0.00529	0.0509	0.113	0.117	0.134
	3	0.108						
	1	0.159						
DU4	2	0.165	0.174	0.0216	0.124	0.211	0.229	0.298
	3	0.199						

^{*} Reporting limit is 0.0400 mg/kg mg/kg = milligrams per kilogram % = percent

Table 6. Soil PRGs Calculated for the Passaic River Residue Site March 2012

		Human Health PRG, T	otal TEQs (ppt)	
Exposure Scenario	Cancer Risk 10 ⁻⁶	Cancer Risk 10 ⁻⁵	Cancer Risk 10 ⁻⁴	Non-Carcinogenic Hazard (IRIS RfD)
Young Child 1 to 6 Years				
HAD	26.2	262	2620	245
HEAST	27.3	273	2730	
CalEPA	31.5	315	3150	
Adolescent7 to 18 Years				
HAD	17.07	170.7	1707	320
HEAST	17.75	177.5	1775	
CalEPA	20.49	204.9	2049	
Outdoor Worker				
HAD	17.01	170.1	1701	664
HEAST	17.69	176.7	1767	
CalEPA	20.41	204.3	2041	
		Human Health PRG, To	otal PCBs (ppm)	
	Cancer Risk 10 ⁻⁶	Cancer Risk 10 ⁻⁵	Cancer Risk 10 ⁻⁴	Non-Carcinogenic Hazard (IRIS RfD)
Young Child 1 to 6 Years; IRIS ¹	1.59	15.9	159	5.46
Adolescent 7 to 18 Years; IRIS ¹	0.762	7.62	76.2	9.13
Outdoor Worker; IRIS ¹	0.826	8.26	82.6	11.8

¹ The oral Rfd for Aroclor 1254 was used to calculate the PRGs, no oral Rfd is available for Aroclor 1260, the only detected Aroclor at this site

PRG = Preliminary remediation Goal

HEAST = EPA's 1997 Health Effects Assessment Summary Table

HAD = Health Assessment Document from EPA's Office of Health and Environmental Assessment; currently the EPA National Center for Environmental Assessment

CalEPa = California EPA

RfD = Reference Dose

PCBs = Polychlorinated biphenyl

TEQ = Toxicity Equivalence Concentration

IRIS = Integrated Risk Information System

ppt = parts per trillion

ppm = parts per million

Table 7. Comparison of COPC Concentrations in Soil with Human Health Screening Benchmarks 95% UCL Soil Concentrations

Passaic River Residue Assessment - March 2012

	Health S	creening Benchmar	k (ppt)		Total TEQs in So	il, 95% UCL (ppt))
Exposure Scenario, Total TEQ (ppt)	Cancer Risk 10 ⁻⁶	Cancer Risk 10 ⁻⁴	Non-Carciongenic Hazard	DU1	DU2	DU3	DU4
Young Child 1 to 6 Years	26.2	2620	246	17.4	13.2	12.5	13.3
Adolescent 7 to 18 Years	17.07	1707	320	17.4	13.2	12.5	13.3
Outdoor Worker	17.01	1701	664	17.4	13.2	12.5	13.3

	Health Screening E	Benchmark (ppm)		1	Total PCBs in Soi	l, 95% UCL (ppm	1)
Exposure Scenario, Polychlorinated Biphenyls (ppm)	Cancer Risk 10 ⁻⁶	Cancer Risk 10 ⁻⁴	Non-Carcinogenic Hazard	DU1	DU2	DU3	DU4
Young Child 1 to 6 Years	1.593	159	5.463	0.0521	0.0317	0.0216	0.0279
Adolescent 7 to 18 Years	0.762	76.2	9.131	0.0521	0.0317	0.0216	0.0279
Outdoor Worker	0.826	82.6	11.804	0.0521	0.0317	0.0216	0.0279

	Health Screening Benchmark (ppm) Non-	Tota	l Mercury in Soi	, 95% UCL (ppm)
	Carcinogenic Hazard	DU1	DU2	DU3	DU4
Total Mercury	23	0.221	0.33	0.113	0.211
MethylMercury	7.8	0.221	0.55	0.115	0.211

% = Percent

TEQ = Toxicity Equivalence Concentration

ppt = Parts per trillion

ppm = Parts per million

UCL = Upper Confidence Limit

Shading indicates exceedance of cancer risk at 10^{-6} human health benchmark

Table 8. Comparison of COPC Concentrations in Soil with Human Health Screening Benchmarks Mean Soil Concentrations

Passaic River Residue Assessment - March 2012

	Health Sc	reening Benchmark	(ppt)		Total TEQs in S	oil, Mean (ppt)	
Exposure Scenario, Total TEQ (ppt)	Cancer Risk 10 ⁻⁶	Cancer Risk 10 ⁻⁴	Non-Carciongenic Hazard	DU1	DU2	DU3	DU4
Young Child 1 to 6 Years	26.2	2620	246	11.9	11.7	8.66	10.5
Adolescent 7 to 18 Years	17.07	1707	320	11.9	11.7	8.66	10.5
Outdoor Worker	17.01	1701	664	11.9	11.7	8.66	10.5

	Health Screening Be	enchmark (ppm)			Total PCBs in So	oil, Mean (ppm)	
Exposure Scenario, Polychlorinated Biphenyls (ppm)	Cancer Risk 10 ⁻⁶	Cancer Risk 10 ⁻⁴	Non-Carcinogenic Hazard	DU1	DU2	DU3	DU4
Young Child 1 to 6 Years	1.593	159	5.463	0.0361	0.0273	0.0152	0.023
Adolescent 7 to 18 Years	0.762	76.2	9.131	0.0361	0.0273	0.0152	0.023
Outdoor Worker	0.826	82.6	11.804	0.0361	0.0273	0.0152	0.023

	Health Screening Benchmark (ppm) Non-	Tot	tal Mercury in So	oil, Mean (ppm)	
	Carcinogenic Hazard	DU1	DU2	DU3	DU4
Total Mercury	23	0.201	0.286	0.104	0.174
MethylMercury	7.8	0.201	0.286	0.104	0.174

% = Percent

TEQ = Toxicity Equivalence Concentration

ppt = Parts per trillion

ppm = Parts per million

UCL = Upper Confidence Limit

Shading indicates exceedance of cancer risk at 10⁻⁶ human health benchmark

APPENDIX A

EPA BASIC KAPLAN-MEIER (KM) TOXICITY EQUIVALENCE (TEQ) CALCULATOR SPREADSHEETS

PASSAIC RIVER RESIDUE SITE

EPA Basic KM TEQ Calculator

Decision Unit 1 - February 2012 Passaic River Assessment W.A. 0-156

DU1-IS-003: Row A

TEC for KM: Row C

value to use for KM: Row B

0.884J

0.884

0.884

3.75

3.75

1.22J

1.22

0.122

2.86J

2.86

0.286

2.72J

2.72

0.272

59.8

59.8

0.598

WHO 2005 TEFs = 0.0003 0.03 0.1 0.1 0.01 0.0003 0.0001 0.0003 0.1 0.1 0.1 0.01 0.1 0.3 0.1 0.1 0.01

1.91J

1.91

0.0573

2.91J

2.91

0.873

6.55

6.55

0.655

3.6J

3.6

0.36

5.00U

5

0.5

2.91J

2.91

0.291

52.1

52.1

0.521

2.38J

2.38

0.0238

78.6

78.6

0.02358

129

129

0.0129

2

2.12

2.93U

2.93

0.000879

Sample ID 1,6-1,9-4,6-1,4-1,6-1,9-1,4,6-1,4-1,4,6-1,4,9-(must enter on Row A) TCDD PeCDD HxCDD HxCDD **HxCDD HpCDD** OCDD TCDF 1-PeCDF 8-PeCDF **HxCDF HxCDF HxCDF HxCDF HpCDF HpCDF** OCDF PCB 77 PCB 81 Sample Notes DU1-IS-001: Row A 0.832J 1.14J 2.27J 1.77J 50.8 641 1.52J 2.34J 5.94 2.58J 5.01U 2.16J 39.2 1.73J 56.5 91.9 2.00U 3.05 3.16 EMPC = J2.27 5.94 2.58 value to use for KM: Row B 3.05 0.832 1.14 1.77 50.8 641 3.16 1.52 2.34 5.01 2.16 39.2 1.73 56.5 91.9 TEC for KM: Row C 3.05 0.832 0.114 0.227 0.177 0.508 0.1923 0.316 0.0456 0.702 0.594 0.258 0.501 0.216 0.392 0.0173 0.01695 0.00919 0.0006 DU1-IS-002: Row A 0.963J 1.35J 3.42J 2.91J 852 2.40J 8.29 4.18J 5.00U 3.37J 2.79J 140 2.12U 6.34 67.3 4.65 3.28J 63.2 94.1 value to use for KM: Row B 6.34 0.963 1.35 3.42 2.91 67.3 852 4.65 2.4 3.28 8.29 4.18 5 3.37 63.2 2.79 94.1 140 TEC for KM: Row C 6.34 0.963 0.135 0.342 0.291 0.673 0.2556 0.465 0.072 0.984 0.829 0.418 0.5 0.337 0.632 0.0279 0.02823 0.014 0.000636

3.75

3.75

0.375

776

776

0.2328

Decision Unit 1 - February 2012 Passaic River Assessment W.A. 0-156

0.00003	0.00003	0.00003	0.00003	0.1	0.00003	0.00003	0.00003	0.03	0.00003 1	intermed	liate		Fraction from nondetect and estimated	
PCB 105	PCB 114	PCB 118	PCB 123	PCB 126	PCB 156	PCB 157	PCB 167	PCB 169	PCB 189	"mean"	nple total T	EQ qualifie	results	
547	18.9	1080	23.1	12	132	132	105	2.00U	22.9					Stats for a DU with triplicate ICSs and TEQ results
547	18.9	1080	23.1	12	132	132	105	2	22.9					
0.01641	0.000567	0.0324	0.000693	1.2	0.00396	0.00396	0.00315	0.06	0.000687	0.3115	9.0348	none	33%	tripl mean triplct SD triplct RSD 1-sided UCL95(t) Chebyshev UCL95 Chebyshev UCL99
839	26.9	1660	42	23.7	217	217	163	2.85U	40					11.9 3.2 0.272 17.4 20.04618 30.49243
839	26.9	1660	42	23.7	217	217	163	2.85	40					Remember, if the RSD is <1.5 , use the t-distribution based, 1-sided 95% UCL.
0.02517	0.000807	0.0498	0.00126	2.37	0.00651	0.00651	0.00489	0.0855	0.0012	0.5314	15.4110	none	26%	If the RSD is between 1.5 and 3 , use the Chebyshev UCL95, and if the RSD >3 ,
655	20.9	1310	35.4	17.3	158	158	127	3.58U	34.6					use the Chebyshev UCL99 (see also the "Calc UCL from triplicate" worksheet).
655	20.9	1310	35.4	17.3	158	158	127	3.58	34.6					, , , , , , , , , , , , , , , , , , ,
0.01965	0.000627	0.0393	0.001062	1.73	0.00474	0.00474	0.00381	0.1074	0.001038	0.388	11.2601	none	32%	

EPA Basic KM TEQ Calculator

Decision Unit 2 - February 2012 Passaic River Assessment W.A. 0-156

WHO 20	05 TEFs =	1	1	0.1	0.1	0.1	0.01	0.0003	0.1	0.03	0.3	0.1	0.1	0.1	0.1	0.01	0.01	0.0003	0.0001	0.0003	0.00003	0.00003	0.00003
	Sample ID																						
	(must enter on			1,4-	1,6-	1,9-	1,4,6-					1,4-	1,6-	1,9-	4,6-	1,4,6-	1,4,9-						
Sample No		TCDD	PeCDD	HxCDD	HxCDD	HxCDD	HpCDD	OCDD	TCDF	1-PeCDF	8-PeCDF	HxCDF	HxCDF	HxCDF	HxCDF	HpCDF	HpCDF	OCDF	PCB 77	PCB 81	PCB 105	PCB 114	PCB 118
DU2-IS-00	1: Row A	5.99	0.588J	0.722J	2.03J	1.57J	36.3	410	3.86	1.5J	1.97J	3.94J	2.05J	0.124J	2.01J	28.2	1.27J	44.5	134	4	546	27.3	1060
to use for K	M: Row B	5.99	0.588	0.722	2.03	1.57	36.3	410	3.86	1.5	1.97	3.94	2.05	0.124	2.01	28.2	1.27	44.5	134	4	546	27.3	1060
EMPC = J	M: Row C	5.99	0.588	0.0722	0.203	0.157	0.363	0.123	0.386	0.045	0.591	0.394	0.205	0.0124	0.201	0.282	0.0127	0.01335	0.0134	0.0012	0.01638	0.000819	0.0318
DU2-IS-00	2: Row A	5.03	0.46J	0.674J	1.61J	1.67J	30.8	353	3.72	1.58J	1.87J	4.11J	2.11J	5.00U	1.92J	26.8	1.3J	42.1	165	4.13	565	28.3	1090
to use for K	M: Row B	5.03	0.46	0.674	1.61	1.67	30.8	353	3.72	1.58	1.87	4.11	2.11	5	1.92	26.8	1.3	42.1	165	4.13	565	28.3	1090
TEC for KI	M: Row C	5.03	0.46	0.0674	0.161	0.167	0.308	0.1059	0.372	0.0474	0.561	0.411	0.211	0.5	0.192	0.268	0.013	0.01263	0.0165	0.001239	0.01695	0.000849	0.0327
DU2-IS-00	3: Row A	5.65	0.788J	0.933J	1.98J	1.89J	40.1	468	3.98	1.8J	2.25J	4.77J	2.29J	5.03U	2.23J	38.9	1.53J	65.2	149	4.84	659	31.4	1260
to use for K	M: Row B	5.65	0.788	0.933	1.98	1.89	40.1	468	3.98	1.8	2.25	4.77	2.29	5.03	2.23	38.9	1.53	65.2	149	4.84	659	31.4	1260
TEC for KI	M: Row C	5.65	0.788	0.0933	0.198	0.189	0.401	0.1404	0.398	0.054	0.675	0.477	0.229	0.503	0.223	0.389	0.0153	0.01956	0.0149	0.001452	0.01977	0.000942	0.0378

Decision Unit 2 - February 2012 Passaic River Assessment W.A. 0-156

0.00003	0.1	0.00003	0.00003	0.00003	0.03	0.00003	l intermed	iate		Fraction from nondetec t and estimated							
PCB 123	PCB 126	PCB 156	PCB 157	PCB 167	PCB 169	PCB 189	"mean"	nple total T	EQ qualifie	results							
24.5	20.7	124	124	91	2.00U	20.8					Stats for a	DU with to	riplicate ICS	Ss and TEQ result	s		
24.5	20.7	124	124	91	2	20.8											
0.000735	2.07	0.00372	0.00372	0.00273	0.06	0.000624	0.4067	11.7951	none	21%	tripl mean	triplct SD	triplct RSD	1-sided UCL95(t)	Chebyshev UCL95	Chebyshev UCL99	
21.6	21.4	125	125	90	2.00U	20.1					11.7	0.9	0.075	13.2	13.88817	16.73221	
21.6	21.4	125	125	90	2	20.1								Remember, if the	RSD is <1.5, use the	t-distribution based, 1-s	ided 95% UCL.
0.000648	2.14	0.00375	0.00375	0.0027	0.06	0.000603	0.3701	10.7343	none	26%				If the RSD is betw	een 1.5 and 3, use the	e Chebyshev UCL95, ar	nd if the RSD >3 ,
25.3	23.2	142	142	106	2.01U	24.1								use the Chebyshe	v UCL99 (see also the	"Calc UCL from triplicat	te" worksheet).
25.3	23.2	142	142	106	2.01	24.1											
0.000759	2.32	0.00426	0.00426	0.00318	0.0603	0.000723	0.430	12.4832	none	27%							

EPA Advanced KM TEQ Calculator

Decision Unit 3 - February 2012

Passaic River Assessment

W.A. 0-156

	WHO 2005 TEFs =	1	1	0.1	0.1	0.1	0.01	0.0003	0.1	0.03	0.3	0.1	0.1	0.1	0.1	0.01	0.01	0.0003	0.0001	0.0003	0.00003	0.00003	0.00003	0.00003	0.1	0.00003
Sample notes	Sample ID: (must enter on Row A)	TCDD	48CDD	\A.H.COD	1,6 th COD	1,9.HXCDD	1,4,6,HQCDD	ocho	TED	\.PeCD ^F	k.P. COF	\A.HXCDF	1.6.HACDE	19.HYCDF	4.6-HACDE	1.A.S.HOCDE	1,49-HPCDF	ocar	PCBT	4C\$8,	PCB 105	PCENA	PCB 18	PCB 123	PCB 126	PCB 186
	DU3-IS-001: Row A	3.43	0.586J	0.592J	1.39J	1.68J	30.7	473	3.3	1.34J	1.97J	3.99J	2.11J	5.00U	1.74J	26.1	1.1J	38.6	113	3.26	455	22.2	886	18.5	19	118
	value to use: Row B	3.43	0.586	0.592	1.39	1.68	30.7	473	3.3	1.34	1.97	3.99	2.11	5	1.74	26.1	1.1	38.6	113	3.26	455	22.2	886	18.5	19	118
1	congener TEC: Row C	3.43	0.586	0.0592	0.139	0.168	0.307	0.1419	0.33	0.0402	0.591	0.399	0.211	0.5	0.174	0.261	0.011	0.01158	0.0113	0.000978	0.01365	0.000666	0.02658	0.000555	1.9	0.00354
	donor value to use: Row D																									
	donor TEC: Row E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	DU3-IS-002: Row A	2.26	0.401J	0.490J	1.28J	1.24J	22	333	1.99	1.1J	1.44J	3.16J	1.31J	4.97U	1.32J	18	1.01J	25.7	61.6	2.31	310	14.2	610	13.9	13.7	79
	value to use: Row B	2.26	0.401	0.49	1.28	1.24	22	333	1.99	1.1	1.44	3.16	1.31	4.97	1.32	18	1.01	25.7	61.6	2.31	310	14.2	610	13.9	13.7	79
2	congener TEC: Row C	2.26	0.401	0.049	0.128	0.124	0.22	0.0999	0.199	0.033	0.432	0.316	0.131	0.497	0.132	0.18	0.0101	0.00771	0.00616	0.000693	0.0093	0.000426	0.0183	0.000417	1.37	0.00237
	donor value to use: Row D																									
	donor TEC: Row E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	DU3-IS-003: Row A	2.15J	4.98U	0.446J	1.17J	1.05J	20.9	287	1.88	1.19J	1.55J	4.63J	1.65J	4.98U	1.27J	19.8	0.927J	27.4	56.6	2	293	13.1	578	13.1	12.6	75
	value to use: Row B	2.15	4.98	0.446	1.17	1.05	20.9	287	1.88	1.19	1.55	4.63	1.65	4.98	1.27	19.8	0.927	27.4	56.6	2	293	13.1	578	13.1	12.6	75
3	congener TEC: Row C	2.15	4.98	0.0446	0.117	0.105	0.209	0.0861	0.188	0.0357	0.465	0.463	0.165	0.498	0.127	0.198	0.00927	0.00822	0.00566	0.0006	0.00879	0.000393	0.01734	0.000393	1.26	0.00225
	donor value to use: Row D		0.493]	0		0	0	•	0	0		•			0	0	0		0	0	0				0

Decision Unit 3 - February 2012

Passaic River Assessment

												Analysis	Sensitivity SECTION 1			Analysis SE				Quasi) Sensitivity Ana					
0.000	03 0.00	0003	0.03	0.00003		Simple Sun	ns	<u> </u>	KM Inter	mediate			EC value is Γ, and there			a NONDETE o rejected ("R		value(s) are present; r	nondetected values ("l	l" or "ND") may or may ı	ot be presei	nt, and the hic	ghest TEC n	nay or may i	not be a non
												Treat	ment 1	Make high	- nent 1: est U value D	comparabl	itute e "donor"	Treatment 1: TEQ as simple sum when R & U treated	when R & U treate	d value is available f	Used values a	tment 4: if "donor" are available		-	
£ 151	- CON	61	PCB 168	och 188	U = 0 &	U = 1/2	U = DL &		Sample		Select KM		Qualifier and		Qualifier and		Qualifier and	Qualifier and	Qualifi	er Qualifie	r	Qualifier	Will sample	Sample ID used	
60,	80,	•	δ _C ,	6 _C ,	sum	DL & sum	n sum	"mean"	KM TEQ	Qualifier	TEQ	KM TEQ	Fraction	KM TEQ	Fraction	KM TEQ	Fraction	KM TEQ Fraction	KM TEQ Fraction	n KM TEQ Fractio	n KM TEC	Fraction	reanalysi	for	Comment
118	88.		2.43	18.1																					
118 0.0035	88.		2.43 0.0729	18.1 0.000543	0.0000	9.1468	9.3968	#N/A	#N/A	#N/A	Section 1	8.9964	none												
0.0035	4 0.002	002	0.0729	0.000543	8.8968	9.1408	9.3968	#IN/A	#IN/A	#N/A	Section 1	8.9964	31%												
0	0		0	0									0170												
79	59.	6	1.99U	12.2																					
79	59.	6	1.99	12.2																					
0.0023	7 0.001	788	0.0597	0.000366	6.1349	6.4133	6.6916	#N/A	#N/A	#N/A	Section 1	6.2418	none												
													35%												
75	0 56.		0 1.99U	0 12.2																					
75 75	56. 56.		1.990	12.2																					
0.0022				0.000366	5 670621	8 439471	11.20832	#N/A	#N/A	#N/A	on 2, Treatn	nent 1		10.7513	J	6.2797	J								
0.0022	0.001	003	0.0031	0.000000	3.070021	. 0.433471	11.20032	#IN/A	#14/ <i>/</i> A	#1 1 //A	, Treath			10.7313	82%	0.2737	70%								
0	0		0	0											2.270		. 2 / 0								

EPA Basic KM TEQ Calculator

Decision Unit 4 - February 2012 Passaic River Assessment W.A. 0-156

Sample Notes	Sample ID (must enter on Row A)	TCDD	PeCDD	1,4- HxCDD	1,6- HxCDD	1,9- HxCDD	1,4,6- HpCDD	OCDD	TCDF	1-PeCDF	8-PeCDF	1,4- HxCDF	1,6- HxCDF	1,9- HxCDF	4,6- HxCDF	1,4,6- HpCDF	1,4,9- HpCDF	OCDF	PCB 77	PCB 81	PCB 105
	DU4-IS-001: Row A	5.5	0.586J	0.761J	2.12J	1.64J	39.4	447	2.2	1.27J	1.62J	4.13J	2.12J	0.122J	1.91J	32	1.55J	50.3	95.5	2.46	395
	value to use for KM: Row B	5.5	0.586	0.761	2.12	1.64	39.4	447	2.2	1.27	1.62	4.13	2.12	0.122	1.91	32	1.55	50.3	95.5	2.46	395
	TEC for KM: Row C	5.5	0.586	0.0761	0.212	0.164	0.394	0.1341	0.22	0.0381	0.486	0.413	0.212	0.0122	0.191	0.32	0.0155	0.01509	0.00955	0.000738	0.01185
EMPC = J	DU4-1S-002: Row A	4.21	0.572J	0.987J	1.72J	1.86J	41.2	488	2.31	1.3J	1.78J	4.26J	2.08J	4.96U	1.85J	32.3	1.74J	49.4	72.6	1.98U	351
	value to use for KM: Row B	4.21	0.572	0.987	1.72	1.86	41.2	488	2.31	1.3	1.78	4.26	2.08	4.96	1.85	32.3	1.74	49.4	72.6	1.98	351
	TEC for KM: Row C	4.21	0.572	0.0987	0.172	0.186	0.412	0.1464	0.231	0.039	0.534	0.426	0.208	0.496	0.185	0.323	0.0174	0.01482	0.00726	0.000594	0.01053
	DU4-IS-003: Row A	6.57	0.575J	0.862J	2.4J	1.87J	47.4	648	2.43	1.28J	1.79J	4.35J	2.31J	5.02U	1.91J	35.6	1.76J	56.1	104	2.73	431
	value to use for KM: Row B	6.57	0.575	0.862	2.4	1.87	47.4	648	2.43	1.28	1.79	4.35	2.31	5.02	1.91	35.6	1.76	56.1	104	2.73	431
	TEC for KM: Row C	6.57	0.575	0.0862	0.24	0.187	0.474	0.1944	0.243	0.0384	0.537	0.435	0.231	0.502	0.191	0.356	0.0176	0.01683	0.0104	0.000819	0.01293

Decision Unit 4 - February 2012 Passaic River Assessment W.A. 0-156

t and estimated

												esiiiiaieu	
PCB 114	PCB 118	PCB 123	PCB 126	PCB 156	PCB 157	PCB 167	PCB 169	PCB 189	"mean"	nple total	TEQ qualifie	results	
16.7	781	17.9	13.4	101	101	77.9	2.00U	17.9					Stats f
16.7	781	17.9	13.4	101	101	77.9	2	17.9					
0.000501	0.02343	0.000537	1.34	0.00303	0.00303	0.002337	0.06	0.000537	0.3584	10.3944	none	24%	tripl m
15.5	732	19	10.6	98.5	98.5	79.7	1.98U	17.7					10.5
15.5	732	19	10.6	98.5	98.5	79.7	1.98	17.7					
0.000465	0.02196	0.00057	1.06	0.002955	0.002955	0.002391	0.0594	0.000531	0.3103	8.9997	none	32%	
17.6	894	22.1	16.6	121	121	96.5	2.01U	21					
17.6	894	22.1	16.6	121	121	96.5	2.01	21					
0.000528	0.02682	0.000663	1.66	0.00363	0.00363	0.002895	0.0603	0.00063	0.422	12.2418	none	24%	En

Stats for a DU	with triplicate	ICSs and	TEQ results
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ripl mean	triplct SD	triplct RSD	1-sided UCL95(t)	Chebyshev UCL95	Chebyshev UCL99	
10.5	1.6	0.154	13.3	14.63806	19.88767	
			Remember, if the	RSD is <1.5, use the t	-distribution based, 1-	sided 95% UCL.
			If the RSD is betwe	een 1.5 and 3, use the	Chebyshev UCL95,	and if the RSD >3,
			use the Chebyshev	UCL99 (see also the "	Calc UCL from triplica	ite" worksheet).

Enter SD used = n used = From what were they selected? (see discussion below the data cells to the left)

Appendix B Trip Report Passaic River Residue January 30 - 31 2012 Lockheed Martin SERAS 2890 Woodbridge Avenue Building 209 Annex Edison, NJ 08837-3679 Telephone 732-321-4200 Facsimile 732-494-4021



DATE:

March 7, 2011

TO:

Marc Greenberg, Ph.D.,

U.S. EPA/OSRTI/TIFSD/ERT Work Assignment Manager

FROM:

Jon McBurney, SERAS Engineering Group Leader/Task Leader

THOUGH:

Dennis Miller, SERAS Program Manager DMX

SUBJECT:

TRIP REPORT: January 30-31, 2012

Passaic River Residue Site, North Arlington, NJ

Work Assignment No. SERAS-156

BACKGROUND

The Lower Passaic River (LPR) is an operable unit of the Diamond Alkali Superfund Site located in Newark, New Jersey (NJ). The LPR 17-mile Remedial Investigation/Feasibility Study (RI/FS) is being conducted by a group of over 70 potentially responsible parties (PRPs) called the Cooperating Parties Group (CPG) under an Administrative Order on Consent (AOC) that was signed in May 2007. The study is scheduled to be completed in 2014. The LPR is tidal and flows from the Dundee Dam at river mile (RM) 17.4 through densely populated and industrialized areas and ultimately into Newark Bay. Beginning in the early nineteenth century, the LPR watershed was a major center for industrial operations including cotton mills, manufactured gas plants, paper manufacturing and chemical manufacturing facilities. These facilities discharged dioxins, petroleum hydrocarbons, polychlorinated biphenyls (PCBs), pesticides and metals to the LPR. Dioxins continue to be a risk driver at the site.

Under this Work Assignment (WA), Scientific Engineering Response and Analytical Services (SERAS) personnel were tasked with providing technical support to the EPA Environmental Response Team (ERT) and EPA Region 2 to conduct limited and focused sampling of selected recreational use areas in the Lower Passaic River Study Area. Due to periodic flooding events, several recreational use areas such as baseball fields, soccer fields, and other public use areas may have been impacted by migration of contaminated sediments from the Passaic River. Sediment deposits collected from the recreational areas will be analyzed for sediment dioxins/furans, mercury, total PCBs and PCB congeners. The data will be used by Region 2 to determine if site conditions exist that could pose a concern for users of recreational areas that warrant further investigation.

In September, 2011, SERAS personnel conducted sampling at North Arlington Football Field, the North Arlington Little League Field, and two soccer fields in South Riverside Park. This field event was focused on four public use areas in the North Riverside Park area in Lyndhurst, NJ (Figure 1).

ACTIVITIES

Monday, January 30, 2012. Four SERAS personnel (J. McBurney, B. Pullen, C. French and S. Richards) arrived at the North Riverside Park area to begin sampling. They were met on site by M. Greenberg (ERT).

DU-1

The task leader (TL), McBurney, began to lay out the sampling grid per the *Quality Assurance Project Plan – Passaic River Residue, North Arlington, NJ* (QAPP) (SERAS 2011). The QAPP outlines the procedure for performing sampling using a method known as Incremental Sampling (IS). This method was developed to provide a statistically based method for determining the average concentration for a given area known as a Decision Unit (DU). The weather during Monday's sampling was cool and clear with a high temperature of 52 degrees Fahrenheit (°F).

The TL verified the dimensions of the first decision unit, DU1 (See Figure 2) by pacing the edges. The DU, located between Joe Job Field and the Passaic River, measured 148 paces (approximately northeast to southwest) by 65 paces (approximately northwest to southeast). Based on an estimated pace distance of 2.6 feet per pace, the area was approximately 1.3 acres. The area was irregularly shaped as shown in Figure 1. Based on these dimensions, a distance between sample locations was calculated to generate the required 30 samples. The long dimension was divided into equal spaces yielding a 16 pace spacing in that direction. The shorter dimension was divided by 4 equal spaces yielding a dimension of 16 paces between samples.

Per the IS method, the initial point of any sampling array must be a random location. To generate the random location, the @randbetween function in Microsoft® Excel was used. A random number was generated for the long and short dimension of the field as follows:

Long Edge Random Dimension: @randbetween(0,65) = 45 paces Short Edge Random Dimension: @randbetween(0,148) = 102 paces

Layout of the IS Sample Array:

- 1. Location of Random Point (Please refer to Figure 2): The TL paced from the northeast (NE) corner of the DU 102 paces southwest (SW), and 45 paces northwest (NW). This was the initial point of the IS which became location DU1-021.
- 2. Location of Start of IS Array: To locate the start of the sampling array, DU1-001, the TL paced two intervals of 16 units (32 paces) SE, and six intervals of 16 paces northeast (NE) (96 paces). An orange flag was placed at the starting point.
- 3. Layout of Row 1 (Please refer to Figure 2): The TL traveled SW 16 paces and placed the second flag (DU1-002). This method was continued until seven flags had been placed along the long dimension of the site, completing the first row.
- 4. Layout of Row 2: The TL then traveled 16 paces NW from the seventh point, and placed the eighth flag, the beginning of the second row. Turning NE, six more flags were placed at 16 pace intervals, completing the second row.
- 5. Layout of Remaining Rows: The procedure of walking NW for 16 paces then creating another row was repeated until four rows (30 locations) were completed (DU1-001 to DU2-030).

Layout of First Replicate Sample:

- 1. To generate a replicate sample to be used to determine the variability of the data collected from the DU, a point offset 5 paces NW and 6 paces SW of DU1-030 was located and marked with a red flag. This point was designated DU1-101.
- 2. Traveling SW first, the TL marked seven more locations 16 paces apart to complete the first row.
- 3. Traveling 16 paces SE, the ninth point was located. Traveling NW, seven more locations were located, completing the second row.
- 4. This method was continued until 30 locations (DU1-101 to DU1-130) were flagged with red flags (Figure 1B.)

Layout of Second Replicate Sample:

- 1. A second replicate sampling grid was required to yield a third sample for the field. This point was generated by starting at point DU1-022 and offsetting the new grid 8 paces NW and 7 paces SW. A yellow flag was placed at this location and designated DU1-201.
- 2. A third grid was laid out by traveling NW first, laying out 2 total locations, traveling 16 paces NW, laying out 4 locations to the SE until 30 locations (DU1-201 to DU1-230) were flagged (Figure 1).

Once all flags had been laid out, sampling commenced. A sampler began at DU1-001. Using a 5-gram Terracore sampler with a custom fabricated collar, fourteen 2-centimeter (cm) deep cores were collected within 1.5 feet of the first flag and placed into an aluminum pan. Four cores were then collected into an 8-oz amber jar for particle size analysis. This procedure was repeated at each orange flag in the order that they were originally laid out. Terracore samplers used to collect the samples into the aluminum pan were reused until no longer usable, going from location to location.

A second sampler commenced sampling at DU1-101, only collecting 14 cores into a clean aluminum pan from each red flag.

A third sampler began sampling in the same manner as the second along the yellow transects beginning at DU1-201.

While sampling was occurring, the TL recorded each sample location using a Trimble GeoXH Global Positioning System (GPS) receiver and data logger. GPS positions are listed in Table 1. It should be noted that DU1 was a wooded area and the GPS data are considered approximate due to the potential for poor reception and reflected satellite signals.

At the completion of the sampling of the first grid, each IS sample was homogenized by breaking up each core plug and then thoroughly mixing. The homogenized sample was divided into two 32-ounce amber jars for PCB, PCB congener, mercury, and Dioxin analyses per the IS procedure.

The first and second replicate samples were homogenized in similar manners, with each being split only between two 32-ounce jars for PCB, PCB congener, mercury, and Dioxin analyses.

DU2

Following the same protocol that was used on DU1, SERAS personnel sampled DU2, located SW of DU1, NW of the pavilion (Figure 3). The initial size of DU2 was checked to be 123 paces by 82 paces (approximately 1.6 acres). The TL then followed the detailed procedure to lay out the three grids and sampling continued as detailed above.

Long Edge Length: 123 Paces, 21 paces between locations (5 equal spaces) Short Edge Length: 82 Paces, 16 paces between locations (4 equal spaces)

Long Edge Random Dimension: @randbetween(0,123) = 103Short Edge Random Dimension: @randbetween(0,82) = 7

Initial Sample Locations: DU2-001 through DU2-030

First Replicate (Red): Offset 8 Paces SW, 11 paces NW, DU2-101 through DU2-130 Second Replicate (Yellow): Offset 6 Paces SW, 4 Paces SE, DU2-201 through DU2-230

The grids and layout methodology are shown on Figure 3; GPS positions are listed in Table 2.

All samples were transported to the SERAS facility in Edison, NJ where they were stored overnight in a locked refrigerator [4 degrees Celsius (°C)].

Tuesday, January 31, 2012. The field team continued sampling on Tuesday at two additional public use areas. The weather during Tuesday's sampling was cool and clear. The temperature was approximately 43 °F in the morning and climbed to around 56 °F in the afternoon.

The first field was designated DU3, and was located SW of the pavilion, NW of the Bocci Courts. The TL then followed the detailed procedure to lay out the three grids and sampling continued as detailed above.

Long Edge Length: 99 Paces, 16 paces between locations (5 equal spaces) Short Edge Length: 66 Paces, 13 paces between locations (4 equal spaces)

Area Size: Approximately 1 acre.

Long Edge Random Dimension: @randbetween(0,99) = 82Short Edge Random Dimension: @randbetween(0,66) = 47

Initial Sample Locations: DU3-001 through DU3-030

First Replicate (red): Offset 8 Paces SE, 5 paces SW, DU3-101 through DU3-130 Second Replicate (yellow): Offset 5 Paces SE, 7 Paces SW, RPF-201 through RPF-230

The grids and layout methodology are shown on Figure 4; GPS positions are listed in Table 3.

The final field designated for sampling was a low-lying public use area located immediately NE of a baseball field and SW of the Bocci Courts. This field was designated DU4. The field was sampled using the methodology previously discussed.

Long Edge Length: 115 Paces, 19 paces between locations (5 equal spaces)
Short Edge Length: 66 Paces, 13 paces between locations (4 equal spaces)

Area Size: Approximately 1.2 acres.

Long Edge Random Dimension: @randbetween(0,115) = 21Short Edge Random Dimension: @randbetween(0,66) = 12

Initial Sample Locations: DU4-001 through DU4-030

First Replicate: Offset 9 Paces E, 5 Paces N, DU4-101 through DU4-130 Second Replicate: Offset 4 Paces E, 4 Paces S, DU4-201 through DU4-130

The grids and layout methodology are shown on Figure 5; GPS positions are listed in Table 4.

All samples were delivered to the SERAS facility in Edison, NJ. The incremental samples were iced, packed and shipped to the Test America Laboratory in West Sacramento, CA for analysis.

Particle Size Results. Particle size analysis per the American Society for Testing and Materials (ASTM) Method D422-62 was performed on one sample per DU by the SERAS Engineering Evaluation Unit (EEU) in Edison, NJ. The results of the analysis are attached as Appendix A and a brief description is given below.

- 1. DU1 The soil sample from DU1 contained moderately sorted clayey, fine to medium sand.
- 2. DU2 The soil sample from DU2 contained moderately sorted clayey, silt to medium sand.
- 3. DU3 The soil sample from DU3 contained moderately sorted clayey, fine to medium sand with some coarse sand.
- 4. DU4 The soil sample from DU4 contained moderately sorted clayey, fine to medium sand with some coarse sand.

Future Activities. Future activities will be at the discretion of the WAM based upon the results of the analysis.

REFERENCE

Quality Assurance Project Plan - Passaic River Residue, North Arlington, NJ, Lockheed Martin SERAS, October 3, 2011, Document No. SERAS-156-DOAPPA1-012312.

User Guide – Uniform Federal Policy – Quality Assurance Project Plan Template for Soils Assessment of Dioxin Sites, United States Environmental Protection Agency, September 2011

Table 1 GPS Coordinates for Decision Unit 1 (DU1) Passaic River Residue February 2012

GPS Date: 1/30/12									
Incremental Sample (Orange)	Replicate 1 (Red)	Replicate 2 (Yellow)							
DU1-001 40.8180446 -74.1338099	DU1-101 40.8182506 -74.1340143	DU1-201 40.8177705 -74.1346950							
DU1-002 40.8179850 -74.1339156	DU1-102 40.8181867 -74.1341060	DU1-202 40.8178688 -74.1347756							
DU1-003 40.8179236 -74.1340072	DU1-103 40.8181717 -74.1341585	DU1-203 40.8179265 -74.1346638							
DU1-004 40.8178224 -74.1341026	DU1-104 40.8180346 -74.1343651	DU1-204 40.8178397 -74.1346159							
DU1-005 40.8177889 -74.1342320	DU1-105 40.8179721 -74.1344403	DU1-205 40.8176907 -74.1345004							
DU1-006 40.8177333 -74.1343306	DU1-106 40.8179419 -74.1345671	DU1-206 40.8176676 -74.1344626							
DU1-007 40.8176605 -74.1344256	DU1-107 40.8178879 -74.1346789	DU1-207 40.8177406 -74.1343580							
DU1-008 40.8177269 -74.1344908	DU1-108 40.8178120 -74.1347655	DU1-208 40.8178164 -74.1344334							
DU1-009 40.8177636 -74.1343979	DU1-109 40.8177671 -74.1347388	DU1-209 40.8178954 -74.1345130							
DU1-010 40.8178483 -74.1342908	DU1-110 40.8178215 -74.1346250	DU1-210 40.8179657 -74.1345841							
DU1-011 40.8178854 -74.1341642	DU1-111 40.8178583 -74.1345288	DU1-211 40.8180083 -74.1344593							
DU1-012 40.8180022 -74.1340705	DU1-112 40.8179076 -74.1344129	DU1-212 40.8179551 -74.1344197							
DU1-013 40.8180660 -74.1339874	DU1-113 40.8179813 -74.1343095	DU1-213 40.8178427 -74.1343347							
DU1-014 40.8181551 -74.1338713	DU1-114 40.8180425 -74.1341894	DU1-214 40.8177822 -74.1342546							
DU1-015 40.8181762 -74.1339054	DU1-115 40.8181043 -74.1340563	DU1-215 40.8178628 -74.1341823							
DU1-016 40.8180711 -74.1340499	DU1-116 40.8181684 -74.1338972	DU1-216 40.8179486 -74.1342112							
DU1-017 40.8180178 -74.1342102	DU1-117 40.8181328 -74.1338381	DU1-217 40.8180409 -74.1342881							
DU1-018 40.8179636 -74.1342652	DU1-118 40.8180601 -74.1340416	DU1-218 40.8180812 -74.1343613							
DU1-019 40.8179146 -74.1343694	DU1-119 40.8179931 -74.1341318	DU1-219 40.8181354 -74.1342482							
DU1-020 40.8178651 -74.1344492	DU1-120 40.8178628 -74.1342838	DU1-220 40.8180205 -74.1341634							
DU1-021 40.8178176 -74.1345544	DU1-121 40.8178452 -74.1343583	DU1-221 40.8179887 -74.1341161							
DU1-022 40.8177651 -74.1346592	DU1-122 40.8177915 -74.1344287	DU1-222 40.8179380 -74.1340531							
DU1-023 40.8178286 -74.1347327	DU1-123 40.8177297 -74.1345313	DU1-223 40.8180182 -74.1339261							
DU1-024 40.8178866 -74.1346080	DU1-124 40.8176278 -74.1344586	DU1-224 40.8180652 -74.1340128							
DU1-025 40.8179180 -74.1345380	DU1-125 40.8177094 -74.1343660	DU1-225 40.8181386 -74.1340691							
DU1-026 40.8179905 -74.1344276	DU1-126 40.8177937 -74.1342530	DU1-226 40.8181983 -74.1341237							
DU1-027 40.8180534 -74.1343338	DU1-127 40.8178497 -74.1341679	DU1-227 40.8182621 -74.1339978							
DU1-028 40.8180969 -74.1342012	DU1-128 40.8179185 -74.1340508	DU1-228 40.8181770 -74.1339293							
DU1-029 40.8180579 -74.1341208	DU1-129 40.8179842 -74.1339576	DU1-229 40.8181417 -74.1339055							
DU1-030 40.8182488 -74.1339616	DU1-130 40.8180285 -74.1338391	DU1-230 40.8180497 -74.1338384							

Table 2
GPS Coordinates for Decision Unit 2
Passaic River Residue
February 2012

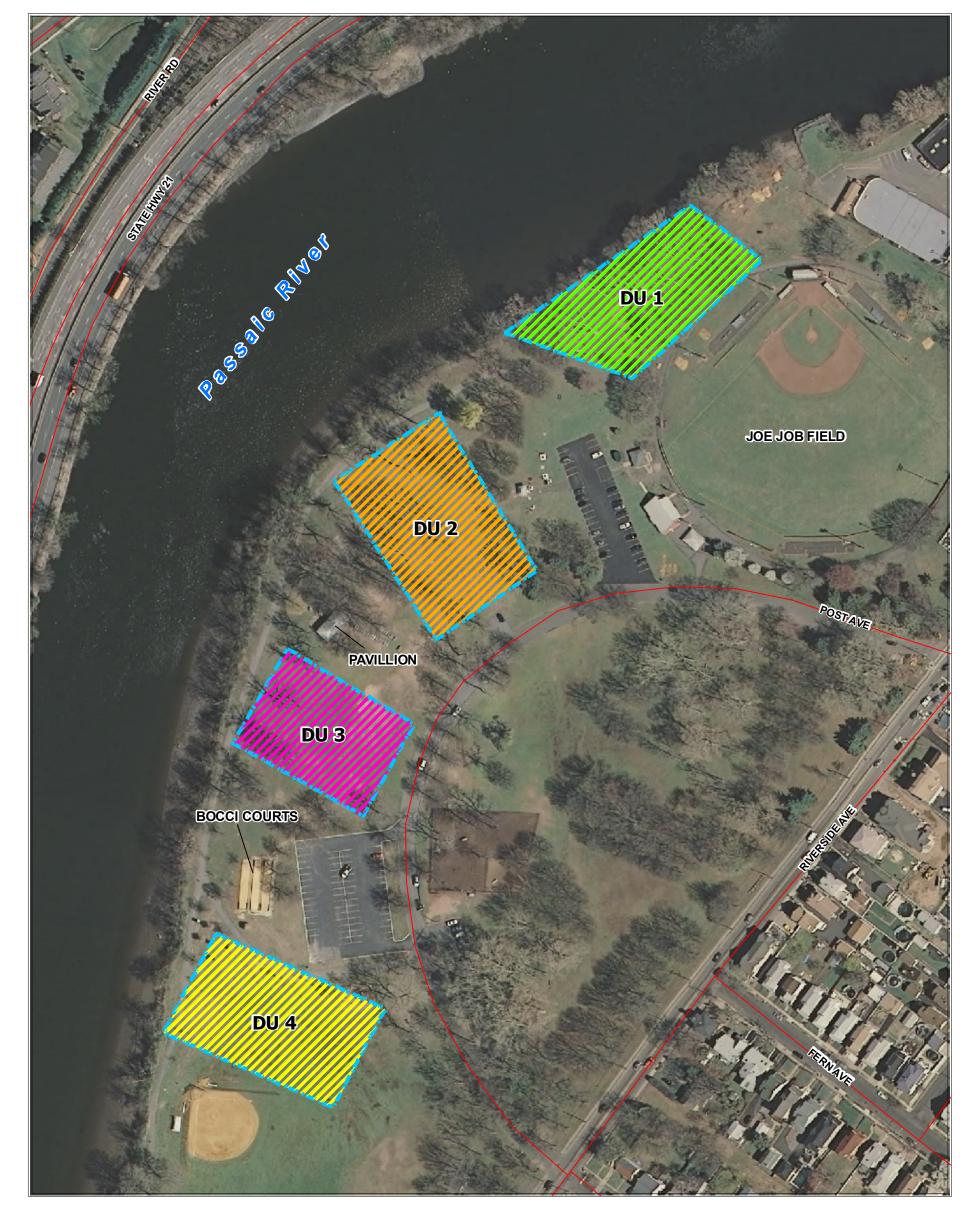
	GPS Date: 1/30/12									
										* 1 L
Incren	Incremental Sample (Orange) Replicate 1 (Red)		Red)		Replicate 2 (Yellow)					
DU2-001	40.8167650	-74.1350550		DU2-101	40.8165554	-74.1355864		DU2-201	40.8170955	-74.1359406
DU2-002	40.8168691	-74.1351346		DU2-102	40.8166655	-74.1356469		DU2-202	40.8171775	-74.1358063
DU2-003	40.8169913	-74.1352197		DU2-103	40.8167903	-74.1357374		DU2-203	40.8172187	-74.1356975
DU2-004	40.8171046	-74.1353016		DU2-104	40.8169035	-74.1358362		DU2-204	40.8172736	-74.1355796
DU2-005	40.8172363	-74.1353805		DU2-105	40.8170381	-74.1359421		DU2-205	40.8173172	-74.1354870
DU2-006	40.8173606	-74.1354728		DU2-106	40.8171308	-74.1360067		DU2-206	40.8171868	-74.1354048
DU2-007	40.8172883	-74.1355661		DU2-107	40.8171705	-74.1359122		DU2-207	40.8171287	-74.1355125
DU2-008	40.8171754	-74.1354557		DU2-108	40.8170816	-74.1358043		DU2-208	40.8170941	-74.1356140
DU2-009	40.8170617	-74.1353959		DU2-109	40.8169631	-74.1357095		DU2-209	40.8170376	-74.1357356
DU2-010	40.8169371	-74.1353248		DU2-110	40.8168271	-74.1356386		DU2-210	40.8169892	-74.1358418
DU2-011	40.8168202	-74.1352476		DU2-111	40.8167157	-74.1355448		DU2-211	40.8168615	-74.1357066
DU2-012	40.8166979	-74.1351639		DU2-112	40.8165975	-74.1354723		DU2-212	40.8169243	-74.1356312
DU2-013	40.8166527	-74.1352517		DU2-113	40.8166531	-74.1353587		DU2-213	40.8169900	-74.1355136
DU2-014	40.8167741	-74.1353370		DU2-114	40.8167768	-74.1354214		DU2-214	40.8170467	-74.1354055
DU2-015	40.8168945	-74.1354245		DU2-115	40.8168906	-74.1355040	88	DU2-215	40.8170850	-74.1353131
DU2-016	40.8170129	-74.1355104		DU2-116	40.8170132	-74.1355847		DU2-216	40.8169641	-74.1352414
DU2-017	40.8171352	-74.1356029		DU2-117	40.8171123	-74.1356647		DU2-217	40.8169114	-74.1353449
DU2-018	40.8172418	-74.1356621		DU2-118	40.8172675	-74.1357330		DU2-218	40.8168706	-74.1354249
DU2-019	40.8171914	-74.1357847		DU2-119	40.8173019	-74.1356416		DU2-219	40.8168011	-74.1355451
DU2-020	40.8170814	-74.1357204		DU2-120	40.8171826	-74.1355721		DU2-220	40.8167456	-74.1356644
DU2-021	40.8169570	-74.1356181		DU2-121	40.8170550	-74.1354770		DU2-221	40.8166189	-74.1355862
DU2-022	40.8168331	-74.1355388		DU2-122	40.8169507	-74.1353726		DU2-222	40.8166858	-74.1354621
DU2-023	40.8167077	-74.1354525		DU2-123	40.8168081	-74.1353006		DU2-223	40.8167423	-74.1353529
DU2-024	40.8165939	-74.1353626		DU2-124	40.8167057	-74.1352279		DU2-224	40.8167961	-74.1352502
DU2-025	40.8165242	-74.1354881		DU2-125	40.8167464	-74.1351294		DU2-225	40.8168423	-74.1351471
DU2-026	40.8166575	-74.1355771		DU2-126	40.8168780	-74.1351935		DU2-226	40.8167277	-74.1350729
DU2-027	40.8167764	-74.1356590		DU2-127	40.8169793	-74.1352715		DU2-227	40.8166732	-74.1351725
DU2-028	40.8168886	-74.1357425		DU2-128	40.8171215	-74.1353590		DU2-228	40.8166259	-74.1352699
DU2-029	40.8170041	-74.1358285		DU2-129	40.8172993	-74.1354753		DU2-229	40.8165593	-74.1353871
DU2-030	40.8171355	-74.1359050		DU2-130	40.8173424	-74.1355528		DU2-230	40.8164945	-74.1354974

Table 3
GPS Coordinates for Decision Unit 3
Passaic River Residue
February 2012

	GPS Date: 1/31/12									
Increm	nental Sample	(Orange)			Replicate 1 (F	Red)		Replicate 2 (Yellow)		
DU3-001	40.8163338	-74.1363733		DU3-101	40.8159923	-74.1365775		DU3-201	40.8157198	-74.1359913
DU3-002	40.8162712	-74.1362512		DU3-102	40.8159134	-74.1364629		DU3-202	40.8157876	-74.1359442
DU3-003	40.8162116	-74.1361365		DU3-103	40.8158680	-74.1363320		DU3-203	40.8158578	-74.1358938
DU3-004	40.8161532	-74.1360204		DU3-104	40.8158196	-74.1362076		DU3-204	40.8159269	-74.1358472
DU3-005	40.8160962	-74.1359065		DU3-105	40.8157706	-74.1360779		DU3-205	40.8159973	-74.1357942
DU3-006	40.8160391	-74.1357900		DU3-106	40.8157239	-74.1359580		DU3-206	40.8160521	-74.1359082
DU3-007	40.8159665	-74.1358377		DU3-107	40.8157843	-74.1359225		DU3-207	40.8159836	-74.1359602
DU3-008	40.8160353	-74.1359613		DU3-108	40.8158275	-74.1360409		DU3-208	40.8159041	-74.1360100
DU3-009	40.8160958	-74.1360781		DU3-109	40.8158855	-74.1361622		DU3-209	40.8158280	-74.1360628
DU3-010	40.8161532	-74.1361932		DU3-110	40.8159399	-74.1362827		DU3-210	40.8157642	-74.1361043
DU3-011	40.8162097	-74.1363104		DU3-111	40.8159871	-74.1363923		DU3-211	40.8158153	-74.1362243
DU3-012	40.8162561	-74.1364228		DU3-112	40.8160573	-74.1365022		DU3-212	40.8158819	-74.1361836
DU3-013	40.8161856	-74.1364793		DU3-113	40.8161332	-74.1364490		DU3-213	40.8159637	-74.1361261
DU3-014	40.8161342	-74.1363739		DU3-114	40.8160794	-74.1363326		DU3-214	40.8160378	-74.1360764
DU3-015	40.8160828	-74.1362619		DU3-115	40.8160282	-74.1362199		DU3-215	40.8161057	-74.1360171
DU3-016	40.8160256	-74.1361463		DU3-116	40.8159735	-74.1361022		DU3-216	40.8161731	-74.1361386
DU3-017	40.8159669	-74.1360284		DU3-117	40.8159115	-74.1359863		DU3-217	40.8161065	-74.1361889
DU3-018	40.8158882	-74.1358880		DU3-118	40.8158574	-74.1358707		DU3-218	40.8160268	-74.1362460
DU3-019	40.8158224	-74.1359525		DU3-119	40.8159287	-74.1358248		DU3-219	40.8159344	-74.1363049
DU3-020	40.8158711	-74.1360811		DU3-120	40.8159882	-74.1359355		DU3-220	40.8158578	-74.1363533
DU3-021	40.8159298	-74.1362141		DU3-121	40.8160483	-74.1360508		DU3-221	40.8158959	-74.1364798
DU3-022	40.8159870	-74.1363380		DU3-122	40.8161084	-74.1361649		DU3-222	40.8159918	-74.1364130
DU3-023	40.8160557	-74.1364455		DU3-123	40.8161663	-74.1362820		DU3-223	40.8160726	-74.1363544
DU3-024	40.8161121	-74.1365529		DU3-124	40.8162219	-74.1363913		DU3-224	40.8161579	-74.1362985
DU3-025	40.8160385	-74.1366055		DU3-125	40.8162900	-74.1363510		DU3-225	40.8162282	-74.1362508
DU3-026	40.8159715	-74.1364655		DU3-126	40.8162309	-74.1362332		DU3-226	40.8162941	-74.1363689
DU3-027	40.8159301	-74.1363917		DU3-127	40.8161695	-74.1361175		DU3-227	40.8162189	-74.1364201
DU3-028	40.8158734	-74.1362681		DU3-128	40.8161053	-74.1360002		DU3-228	40.8161312	-74.1364789
DU3-029	40.8158185	-74.1361362		DU3-129	40.8160492	-74.1358830		DU3-229	40.8160494	-74.1365361
DU3-030	40.8157668	-74.1359940		DU3-130	40.8159954	-74.1357693		DU3-230	40.8159677	-74.1365861

Table 4
GPS Coordinates for Decision Unit 4
Passaic River Residue
February 2012

	GPS Date: 1/31/12									
				198						
Increm	nental Sample	(Orange)			Replicate 1 (F	Red)		R	eplicate 2 (Ye	ellow)
DU4-001	40.8150727	-74.1368348		DU4-101	40.8147342	-74.1369184		DU4-201	40.8144799	-74.1363025
DU4-002	40.8150190	-74.1366926		DU4-102	40.8146841	-74.1367653		DU4-202	40.8145552	-74.1362639
DU4-003	40.8149752	-74.1365384		DU4-103	40.8146336	-74.1366046		DU4-203	40.8146303	-74.1362169
DU4-004	40.8149136	-74.1363874		DU4-104	40.8145834	-74.1364565		DU4-204	40.8147087	-74.1361676
DU4-005	40.8148565	-74.1362345		DU4-105	40.8145312	-74.1363056		DU4-205	40.8147861	-74.1361215
DU4-006	40.8148004	-74.1360785		DU4-106	40.8144893	-74.1361867		DU4-206	40.8148431	-74.1362635
DU4-007	40.8147254	-74.1361206		DU4-107	40.8145633	-74.1361467		DU4-207	40.8147654	-74.1363174
DU4-008	40.8147769	-74.1362773		DU4-108	40.8146092	-74.1362878		DU4-208	40.8146865	-74.1363662
DU4-009	40.8148274	-74.1364337		DU4-109	40.8146592	-74.1364263		DU4-209	40.8146038	-74.1364132
DU4-010	40.8148811	-74.1365867		DU4-110	40.8147103	-74.1365666		DU4-210	40.8145274	-74.1364559
DU4-011	40.8149385	-74.1367384		DU4-111	40.8147634	-74.1367108		DU4-211	40.8145791	-74.1365817
DU4-012	40.8149852	-74.1368828		DU4-112	40.8148150	-74.1368629		DU4-212	40.8146544	-74.1365473
DU4-013	40.8149029	-74.1369119		DU4-113	40.8149079	-74.1368291		DU4-213	40.8147386	-74.1365062
DU4-014	40.8148604	-74.1367665		DU4-114	40.8148566	-74.1366815		DU4-214	40.8148176	-74.1364647
DU4-015	40.8148121	-74.1366153		DU4-115	40.8148062	-74.1365373		DU4-215	40.8149000	-74.1364198
DU4-016	40.8147496	-74.1364725		DU4-116	40.8147536	-74.1363866		DU4-216	40.8149504	-74.1365714
DU4-017	40.8146967	-74.1363299		DU4-117	40.8146975	-74.1362380		DU4-217	40.8148726	-74.1366180
DU4-018	40.8146417	-74.1361807		DU4-118	40.8146432	-74.1360976		DU4-218	40.8147950	-74.1366557
DU4-019	40.8145680	-74.1362262		DU4-119	40.8147256	-74.1360542		DU4-219	40.8147069	-74.1366975
DU4-020	40.8146179	-74.1363744		DU4-120	40.8147812	-74.1362011		DU4-220	40.8146235	-74.1367331
DU4-021	40.8146674	-74.1365241		DU4-121	40.8148288	-74.1363519		DU4-221	40.8146787	-74.1368859
DU4-022	40.8147158	-74.1366719		DU4-122	40.8148849	-74.1364988		DU4-222	40.8147583	-74.1368500
DU4-023	40.8147641	-74.1368171		DU4-123	40.8149399	-74.1366481		DU4-223	40.8148446	-74.1368056
DU4-024	40.8148116	-74.1369570		DU4-124	40.8149925	-74.1367904		DU4-224	40.8149236	-74.1367658
DU4-025	40.8147334	-74.1369949		DU4-125	40.8150631	-74.1367510		DU4-225	40.8150080	-74.1367246
DU4-026	40.8146832	-74.1368454		DU4-126	40.8150130	-74.1366049		DU4-226	40.8150552	-74.1368636
DU4-027	40.8146321	-74.1366980		DU4-127	40.8149635	-74.1364615		DU4-227	40.8149743	-74.1369085
DU4-028	40.8145790	-74.1365522		DU4-128	40.8149111	-74.1363151		DU4-228	40.8148930	-74.1369503
DU4-029	40.8145351	-74.1364172		DU4-129	40.8148559	-74.1361628		DU4-229	40.8148049	-74.1369933
	40.8144853	-74.1362813		DU4-130	40.8147950	-74.1360133		DU4-230	40.8147235	-74.1370297







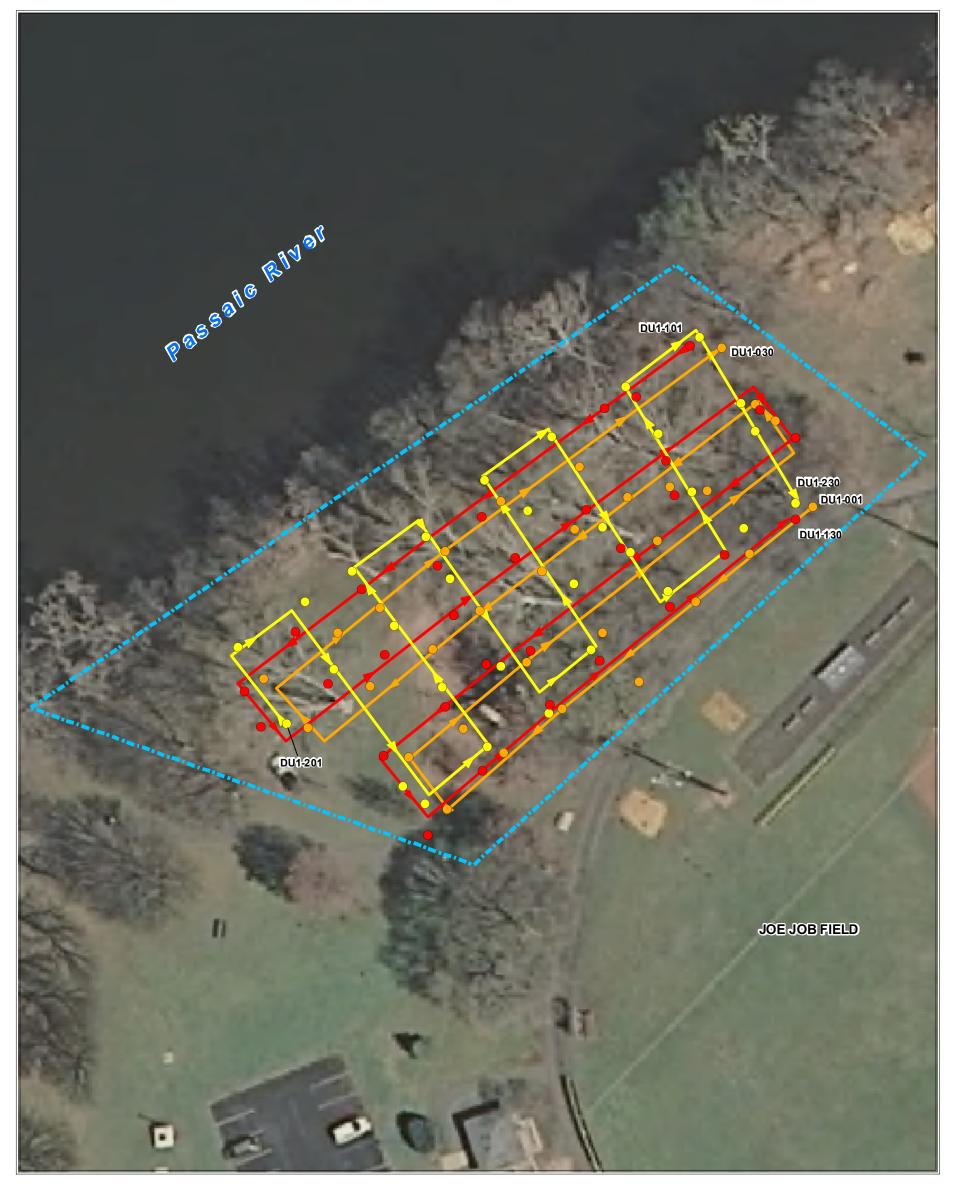
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Datum: NAD83
Units: Feet

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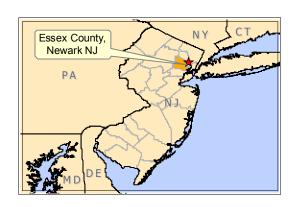


U.S EPA Environmental Response Team Scientific Engineering Response and Analytical Services EP-W-09-031 W.A.# 0-156

Figure 1 Site Layout Map Passaic River Residue Newark, New Jersey

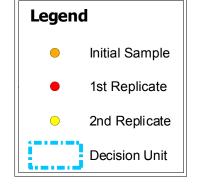


Map Creation Date: 01 February 2012 Coordinate system: New Jersey State Plane FIPS: 2900 Datum: NAD83 Units: Feet



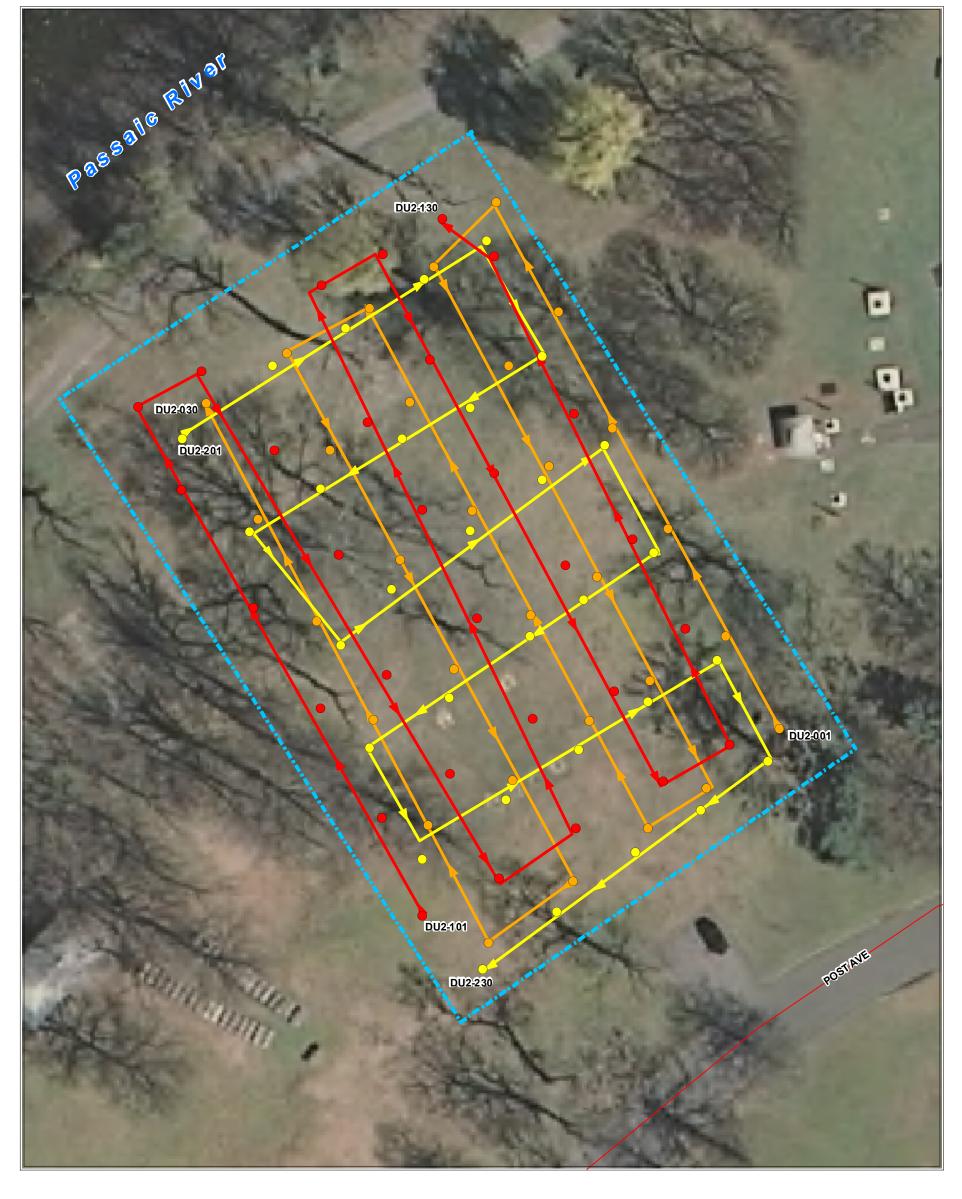




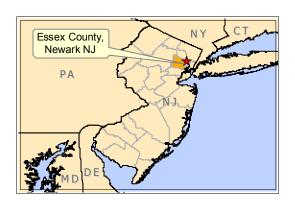


U.S EPA Environmental Response Team Scientific Engineering Response and Analytical Services EP-W-09-031 W.A.# 0-156

Figure 2 Site Sampling Map Passaic River Residue Decision Unit 1 Newark, New Jersey

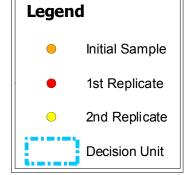


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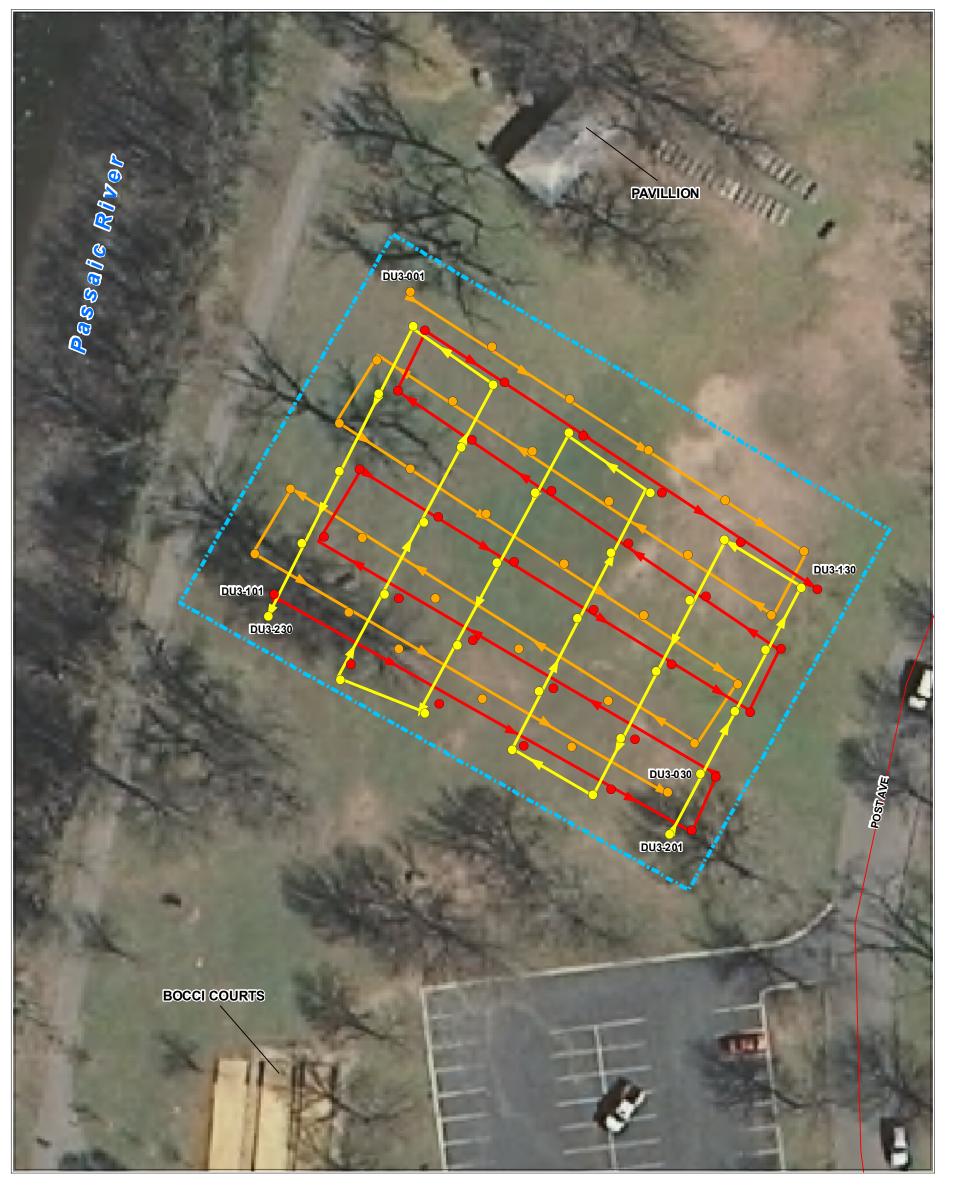




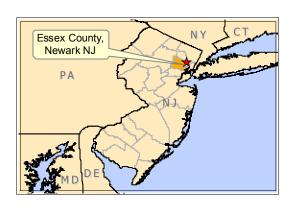


U.S EPA Environmental Response Team Scientific Engineering Response and Analytical Services EP-W-09-031 W.A.# 0-156

Figure 3 Site Sampling Map Passaic River Residue Decision Unit 2 Newark, New Jersey

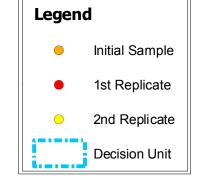


Map Creation Date: 01 February 2012 Coordinate system: New Jersey State Plane FIPS: 2900 Datum: NAD83 Units: Feet







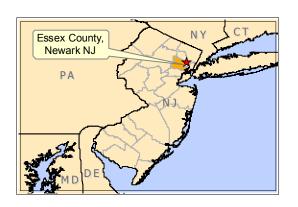


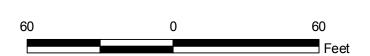
U.S EPA Environmental Response Team Scientific Engineering Response and Analytical Services EP-W-09-031 W.A.# 0-156

Figure 4 Site Sampling Map Passaic River Residue Decision Unit 3 Newark, New Jersey



Map Creation Date: 01 February 2012 Coordinate system: New Jersey State Plane FIPS: 2900 Datum: NAD83 Units: Feet







Legend Initial Sample 1 st Replicate 2 nd Replicate **Decision Unit**

U.S EPA Environmental Response Team Scientific Engineering Response and Analytical Services EP-W-09-031 W.A.# 0-156

Figure 5 Site Sampling Map Passaic River Residue Decision Unit 4 Newark, New Jersey

Appendix A
Particle Size Results
Passaic River Residue
March 2012

PARTICLE SIZE ANALYSIS

ASTM D422-63

Jon McBurney
02/27/12
Passaic River Residue
156-0134 DU1-IS-001

Sample Data

Mass retained on No. 10 sieve (g):	10.77	
Mass passing No. 10 sieve (g):	223.13	
Total Mass of sample split on No. 10 sieve (g):	233.9	
Percent passing No. 10 sieve (g):	95.40	
Mass used in Hydrometer test (g):	100	
Specific gravity of soil:	2.65	
Correction factor:	1	
Corrected mass of soil used in hydrometer test (g):	100	

Hygroscopic Moisture

Wc = Mass of Crucible (g)	99.99
W1 = Wc + Wet mass of hygroscopic test sample (g):	130.37
W2 = Wc + Oven-dry mass of test sample (g):	129.76
Percent hygroscopic moisture:	2.05%
Corrected mass of soil	
used in hydrometer test (g):	97.95

Hydrometer Test

Hydrometer type:	151H	
Hydrometer correction:		0.0005
Average temperature (C):		21
Temperature correction factor:		0
Total Hydrometer correction:		0.0005

Values

K:	0.01365
W:	102.68
F:	4.73

::

Results 156-0134 DU1-IS-001

Sieve Analysis

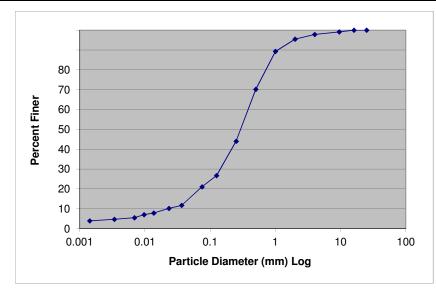
	Retained (g)				Percent Finer Than
25	0.00	0.00	0.00	102.68	100.00
16	0.00	0.00	0.00	102.68	100.00
9.5	2.02	2.01	0.88	101.80	99.14
4	3.03	3.02	1.32	100.47	97.85
2	5.57	5.54	2.43	98.04	95.48

Hydrometer Test Analysis

Time, T	Hydrometer	Corrected	Length, L (cm)	Diameter	Percent
· · · · · · · · · · · · · · · · · · ·	Reading	Reading	- 3- / (- /		Suspended
2	1.008	1.0075	14.31	0.0365	11.73
5	1.007	1.0065	14.58	0.0233	10.17
15	1.0055	1.005	14.97	0.0136	7.82
30	1.005	1.0045	15.10	0.0097	7.04
60	1.004	1.0035	15.37	0.0069	5.47
250	1.0035	1.003	15.50	0.0034	4.69
1440	1.003	1.0025	15.63	0.0014	3.91

Sieve Analysis < No.10

Size (mm)	Mass Retained (g)	Mass Passing (g)	Percent Finer Than
1	6.23	91.72	89.33
0.5	19.62	72.10	70.22
0.25	26.88	45.22	44.04
0.125	17.77	27.45	26.73
0.075	5.82	21.63	21.07
TOTAL	76.32		



ASTM	Particle	Percent
Grain Size	Dia. (mm)	Finer
	25	100.00
Fine	16	100.00
Gravel	9.5	99.14
Course	4	97.85
Sand	2	95.48
Medium	1	89.33
Sand	0.5	70.22
	0.25	44.04
Fine Sand	0.125	26.73
	0.075	21.07
	0.0365	11.73
	0.0233	10.17
Silt	0.0136	7.82
	0.0097	7.04
	0.0069	5.47
	0.0034	4.69
Clay	0.0014	3.91

PARTICLE SIZE ANALYSIS

ASTM D422-63

Technician's name:	Jon McBurney
Date:	02/27/12
	-
Site name:	Passaic River Residue
Sample No.:	156-0137 DU2-IS-001
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Sample Data

Mass retained on No. 10 sieve (g):	3.12
Mass passing No. 10 sieve (g):	252.35
Total Mass of sample split on No. 10 sieve (g):	255.47
Percent passing No. 10 sieve (g):	98.78
Mass used in Hydrometer test (g):	100
Specific gravity of soil:	2.65
Correction factor:	1
Corrected mass of soil used in hydrometer test (g):	100

Hygroscopic Moisture

Wc = Mass of Crucible (g)	99.44
W1 = Wc + Wet mass of hygroscopic test sample (g):	130.31
W2 = Wc + Oven-dry mass of test sample (g):	129.86
Percent hygroscopic moisture:	1.48%
Corrected mass of soil	
used in hydrometer test (g):	98.52

Hydrometer Test

Values

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Hydrometer type:	151H	
Hydrometer correction:		0.0005
Average temperature (C):		21
Temperature correction factor:		0
Total Hydrometer correction:		0.0005

Total Hydrometer correction:

K:	0.0136
W:	99.74
F:	1.22

Results 156-0137 DU2-IS-001

Sieve Analysis

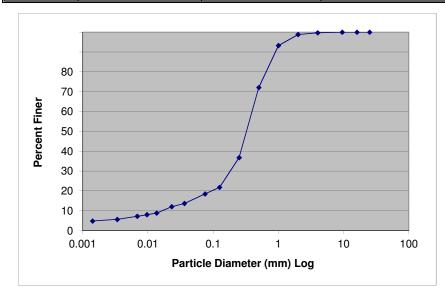
	Mass Retained (g)		Mass Retained Corrected for F (g)		Percent Finer Than
Ì	(0)	Retained (g)	(6)	<i>3</i> (3)	
25	0.00	0.00	0.00	99.74	100.00
16	0.00	0.00	0.00	99.74	100.00
9.5	0.00	0.00	0.00	99.74	100.00
4	0.79	0.79	0.31	99.43	99.69
2	2.17	2.16	0.84	98.59	98.85
	2.96				

Hydrometer Test Analysis

Time, T	Hydrometer	Corrected	Length, L (cm)	Diameter	Percent
(Minutes)	Reading	Reading		(mm)	Suspended
2	1.009	1.0085	14.05	0.0362	13.69
5	1.008	1.0075	14.31	0.0231	12.08
15	1.006	1.0055	14.84	0.0136	8.86
30	1.0055	1.005	14.97	0.0096	8.05
60	1.005	1.0045	15.10	0.0068	7.25
250	1.004	1.0035	15.37	0.0034	5.64
1440	1.0035	1.003	15.50	0.0014	4.83

Sieve Analysis <No.10

Oleve Allalysis (140.10				
Size (mm)	Mass Retained (g)	Mass Passing (g)	Percent Finer Than	
1	5.49	93.03	93.27	
0.5	21.08	71.95	72.14	
0.25	35.25	36.70	36.80	
0.125	14.94	21.76	21.82	
0.075	3.34	18.42	18.47	
TOTAL	80.10			



ASTM	Particle	Percent
Grain Size	Dia. (mm)	Finer
	25	100.00
Fine	16	100.00
Gravel	9.5	100.00
Course	4	99.69
Sand	2	98.85
Medium	1	93.27
Sand	0.5	72.14
	0.25	36.80
Fine Sand	0.125	21.82
	0.075	18.47
	0.0362	13.69
	0.0231	12.08
Silt	0.0136	8.86
	0.0096	8.05
	0.0068	7.25
	0.0034	5.64
Clay	0.0014	4.83

PARTICLE SIZE ANALYSIS

ASTM D422-63

Technician's name:	Jon McBurney	
Date:	02/27/12	
Site name:	Passaic River Residue	
Sample No.:	156-0140 DU3-IS-001	
	<u>-</u>	

Sample Data

Mass retained on No. 10 sieve (g):	5.84	
Mass passing No. 10 sieve (g):	236.62	
Total Mass of sample split on No. 10 sieve (g):	242.46	
Percent passing No. 10 sieve (g):	97.59	
	<u></u>	
Mass used in Hydrometer test (g):	100	
Specific gravity of soil:	2.65	
Correction factor:	1	

100

Hygroscopic Moisture

Corrected mass of soil used in hydrometer test (g):

Wc = Mass of Crucible (g)	104.3
W1 = Wc + Wet mass of hygroscopic test sample (g):	130.59
W2 = Wc + Oven-dry mass of test sample (g):	130.25
Percent hygroscopic moisture:	1.31%
Corrected mass of soil	
used in hydrometer test (g):	98.69

Hydrometer Test

Hydrometer type:	151H	
Hydrometer correction:		0.0005
Average temperature (C):		21
Temperature correction factor:		0
Total Hydrometer correction:		0.0005

Values

K:	0.01365
W:	101.13
F:	2.44

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Results 156-0140 DU3-IS-001

Sieve Analysis

Sieve / trialyele					_
Sieve Size	Mass	Hygroscopic	Mass Retained	Mass	Percent
(mm)	Retained (g)	Corrected Mass	Corrected for F (g)	Passing (g)	Finer Than
	, C	Retained (g)	, c,	O 1.0,	
25	0.00	0.00	0.00	101.13	100.00
16	0.00	0.00	0.00	101.13	100.00
9.5	0.00	0.00	0.00	101.13	100.00
4	1.19	1.19	0.50	100.63	99.51
2	4.18	4.17	1.74	98.89	97.79

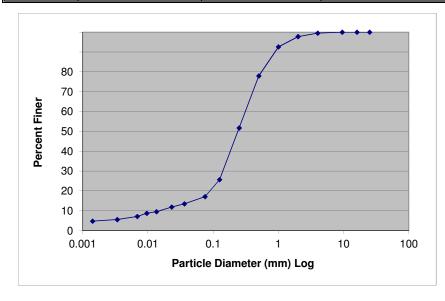
5.37

Hydrometer Test Analysis

Time, T	Hydrometer	Corrected	Length, L (cm)	Diameter	Percent
(Minutes)	Reading	Reading		(mm)	Suspended
2	1.009	1.0085	14.05	0.0362	13.50
5	1.008	1.0075	14.31	0.0231	11.91
15	1.0065	1.006	14.71	0.0135	9.53
30	1.006	1.0055	14.84	0.0096	8.74
60	1.005	1.0045	15.10	0.0068	7.15
250	1.004	1.0035	15.37	0.0034	5.56
1440	1.0035	1.003	15.50	0.0014	4.76

Sieve Analysis <No.10

Gieve Atlatysis Civo. 10			
Size (mm)	Mass Retained (g)	Mass Passing (g)	Percent Finer Than
1	5.02	93.67	92.63
0.5	14.83	78.84	77.96
0.25	26.51	52.33	51.75
0.125	26.34	25.99	25.70
0.075	8.65	17.34	17.15
TOTAL	81.35		



ASTM	Particle	Percent
Grain Size	Dia. (mm)	Finer
	25	100.00
Fine	16	100.00
Gravel	9.5	100.00
Course	4	99.51
Sand	2	97.79
Medium	1	92.63
Sand	0.5	77.96
	0.25	51.75
Fine Sand	0.125	25.70
	0.075	17.15
	0.0362	13.50
	0.0231	11.91
Silt	0.0135	9.53
	0.0096	8.74
	0.0068	7.15
	0.0034	5.56
Clay	0.0014	4.76

PARTICLE SIZE ANALYSIS

ASTM D422-63

Technician's name:	Jon McBurney
Date:	02/27/12
	•
Site name:	Passaic River Residue
Sample No.:	156-0143 DU4-IS-001
•	

Sample Data

Mass retained on No. 10 sieve (g):	1.7	
Mass passing No. 10 sieve (g):	194.92	
Total Mass of sample split on No. 10 sieve (g):	196.62	
Percent passing No. 10 sieve (g):	99.14	
Mass used in Hydrometer test (g):	100	
Specific gravity of soil:	2.65	
Correction factor:	1	

Hygroscopic Moisture

Wc = Mass of Crucible (g)	102.93
W1 = Wc + Wet mass of hygroscopic test sample (g):	130.1
W2 = Wc + Oven-dry mass of test sample (g):	129.58
Percent hygroscopic moisture:	1.95%
Corrected mass of soil	
used in hydrometer test (g):	98.05

Hydrometer Test

Hydrometer type:	151H	
Hydrometer correction:		0.0005
Average temperature (C):		21
Temperature correction factor:		0
Total Hydrometer correction:		0.0005

Values

K:	0.01365
W:	98.90
F:	0.86
::	

Results 156-0143 DU4-IS-001

Sieve Analysis

	107	, ,	Mass Retained Corrected for F (g)		Percent Finer Than
25	0.00	0.00	0.00	98.90	100.00
16	0.00	0.00	0.00	98.90	100.00
9.5	0.00	0.00	0.00	98.90	100.00
4	0.53	0.53	0.27	98.64	99.73
2	0.84	0.84	0.42	98.22	99.31

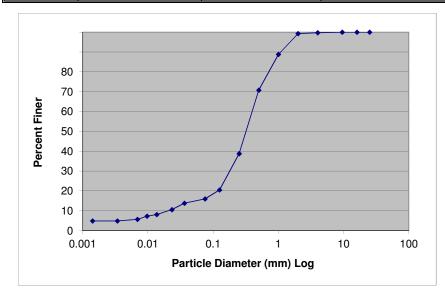
1.37

Hydrometer Test Analysis

Time, T	Hydrometer	Corrected	Length, L (cm)	Diameter	Percent
(Minutes)	Reading	Reading		(mm)	Suspended
2	1.009	1.0085	14.05	0.0362	13.80
5	1.007	1.0065	14.58	0.0233	10.56
15	1.0055	1.005	14.97	0.0136	8.12
30	1.005	1.0045	15.10	0.0097	7.31
60	1.004	1.0035	15.37	0.0069	5.68
250	1.0035	1.003	15.50	0.0034	4.87
1440	1.0035	1.003	15.50	0.0014	4.87

Sieve Analysis <No.10

Gieve Attatysis VIVO.10					
Size (mm)	Mass Retained (g)	Mass Passing (g)	Percent Finer Than		
1	10.18	87.87	88.84		
0.5	17.83	70.04	70.81		
0.25	31.70	38.34	38.76		
0.125	18.06	20.28	20.50		
0.075	4.47	15.81	15.98		
TOTAL	82.24				



ASTM	Particle	Percent
Grain Size	Dia. (mm)	Finer
	25	100.00
Fine	16	100.00
Gravel	9.5	100.00
Course	4	99.73
Sand	2	99.31
Medium	1	88.84
Sand	0.5	70.81
	0.25	38.76
Fine Sand	0.125	20.50
	0.075	15.98
	0.0362	13.80
	0.0233	10.56
Silt	0.0136	8.12
	0.0097	7.31
	0.0069	5.68
	0.0034	4.87
Clay	0.0014	4.87